THIRD

ANNUAL REPORT

OF THE

FOLKESTONE

NATURAL HISTORY SOCIETY,

WITH

STATEMENT OF ACCOUNTS,

AND

FULL LIST OF THE SOCIETY,

For the Year ending December 31st, 1870.

PRINTED FOR THE
FOLKESTONE NATURAL HISTORY SOCIETY
1871.

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PRINTED BY J. ENGLISH, HIGH STREET, FOLKESTONE.

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Whittingham, Mr.
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Yunge, Mrs.

BALANCE SHEET.

Dr. Receipts.	£	s.	d.	Cr. Expenses.	£	s.	d.
To Balance from last year	£3	2	11	By Printing and Stationery	£10	19	6
„ Subscriptions	16	0	6	„ Advertising	1	15	6
„ Received at Lectures 1869-70	1	17	0	„ Postage	1	18	5
„ Received from Botany Class	3	6	6	„ Hire of Rooms	8	13	0
„ Sale of Magazines	0	15	9	„ Mr. Griffith, for Fossils	2	10	0
„ „ List of Lepidoptera	1	12	1	„ Writing Table	2	2	0
„ Received for "General Fund"	2	9	0	„ Sundries	2	11	2
	£29	3	9		£30	9	7
Balance due to the Treasurer	£1	5	10				

H. ULLYETT, *Hon. Treasurer.*

REPORT

OF THE

FOLKESTONE NATURAL HISTORY SOCIETY.

AT the close of the third year of the Society's existence, your Committee have pleasure in reporting on its continued success. The number of Members now reaches 150, being an increase of 32 during the past twelve months. The attendance of Members both on field days and at the Conversaziones has been on the whole very good indeed, which may be taken as a proof that the interest in the work of the Society is not flagging.

A most important work, and one involving some considerable responsibility, has been taken in hand by the Society during the year. It will be remembered that at the last annual meeting your Committee had occasion to express regret that the the Museum of the town had not as yet been placed under the charge of some one competent and willing to clean and arrange the specimens. Your committee are however, now happy in being able to state that all difficulties have been conquered, and by the kindness and liberality of the Corporation of Folkestone, the Sessions Hall in High Street has been thoroughly renovated and stocked with suitable cases, in which most of the objects have been placed. The Society is greatly indebted to several of its own Members—ladies and gentlemen, who under the guidance of the Rev. C. L. ACLAND afforded invaluable help in cleaning, arranging, and mounting the specimens. It is true the room is small, and not perhaps all that could be wished, nevertheless, it is the best for the purpose that at present exists in the town, and therefore we must be thankful. Your Committee have undertaken to keep it in order and throw it open to the public free once a week in winter and twice a week in summer; the Corporation in return have

given the Society the free use of the room for meetings and lectures. Up to the present time there has been no falling off in the number of Visitors to the Museum. It is hardly necessary for your Committee to say that all this has involved a considerable outlay from the funds of the Society, in addition to the aid granted by the Corporation, and they have, as the members are mostly aware issued an appeal in the hope of receiving contributions in aid of the formation of a Museum Fund. They earnestly hope that the appeal will meet with a response though as yet they have been disappointed at the small amount subscribed.

They would also remind the members that they would confer a benefit on the Society by purchasing the publications —a large stock of the Quarterly Journals, and the List of Butterflies and Moths remaining on hand, thus causing a serious deficiency in the funds.

The Class formed last winter for instruction in Botany has been resumed this session, and has been well attended. In addition, another class has been formed for conversational lectures in Geology, and this too musters a goodly number of students.

A Library in connection with the Society is in course of formation, and your Committee will be happy to receive donations towards it either in books or money.

There is also kept at the Museum an album for the insertion of notes on any occurrence in the neighbourhood which is likely to prove of interest to the members of the Society.

There is one circumstance, however, which your Committee have great occasion to regret, and their feelings will undoubtedly be shared by all the members—the departure from Folkestone of the Rev. C. L. Acland, who has hitherto been, they may almost say, the mainstay of the Society. It is mainly through his endeavours that the Society has become so flourishing, and that the Museum has been placed in its present state, and they greatly fear that a long time will elapse before the vacancy caused by his departure can be filled.

The Balance Sheet of the Treasurer for the year 1870 is before you, from which it will be seen that for the first time in the history of the Society there is a deficit; the full extent of this however does not appear, as there are several outstanding accounts.—(See p. 6.)

THE

SECOND ANNUAL MEETING

The Second Annual Meeting was held at the Commercial Hall on the evening of Tuesday, January 18th, 1870.

On the table were collections of

Folkestone Fossils,
Land and Freshwater Shells,
Marine Shells,
Madrepores,
Dried Plants,

lent by the SECRETARY; also Nests of Weaver Birds, lent by Miss MALLANDAINE; Eggs and Fossils, lent by Mr. PLACE.

The PRESIDENT commenced the Business of the evening by reading the following

ADDRESS :—

Ladies and Gentlemen,

It is with no ordinary feeling of gratification I address you this evening, on the occasion of our Second Annual Meeting; if I, in common with you all, hailed with pleasure the formation of a Society for the cultivation of Natural History; if I watched with pride its steady progress and increase for the first year, how much more pleasurable are my feelings when I look around to-night, and am enabled to congratulate you on having a Society, founded on a solid basis, consisting of 118 members, and so ably represented by the smiling and intelligent faces I see around me. We have had some very clever papers read during the course of the year, and an admirable example, which was nobly set by a lady member last year, has been repeated by two others of our fair members, who have contributed very interesting papers on local Botany, and Domestic Birds, and if these were slightly imbued with an element of romance, which they tell me is quite inseparable from the female character, surely this rather increased

than diminished their value! Our kind friend, Mr. Acland, who may well be called the backbone of the Society, has not only contributed several valuable papers, but he has been and is now delivering a course of Lectures on Botany, for which he has deservedly gained the cordial gratitude of our Society. Our untiring and clever Secretary, Mr. Ullyett, has not been behindhand in contributing his share to our success, and Dr. Knaggs has made out a list of local Lepidoptera, which is, in a scientific point of view, invaluable, while Mr. Dashwood sets an example to-night, which I would fain see more extensively imitated, by giving us a paper on Birds. We sadly want more working members; each of you might so easily and pleasantly contribute something towards building up the Edifice of Science—each might bring one brick; I mean there are so many points on which we want to throw light and to get all available evidence—and here all might help. So many debateable questions to be answered, for example, Do, or do not, Swallows, Sandmartins, &c. hybernate? There are many instances of their being seen in England in October, November, and December, and again in March. Are these late departures or early arrivals? have they been hybernating in old walls, sandbanks, &c., where they are said to have been found by reliable witnesses? It is not many years since Swallows were believed, even by scientific men, to hybernate under water, though this notion is now exploded. Now this, for example, is a mystery you might all help to clear up by a little trained and intelligent observation, and by a careful noting of facts. Again, Do Toads live in air-tight holes and other cavities for unheard of times? Are the stories we hear to this effect fact or fiction? Are Birds fascinated by Snakes, and Butterfles by Lizards? Do Vipers swallow their young when alarmed? There is a very interesting discussion going on at this momeut in "Land and Water" on this subject; here again is a case in which every individual experience is all-important. There are deeper questions than this in Natural Science to which no one can at present return a satisfactory answer, for example, What is Gravitation? Gravitation, which Sir John Herschell justly calls "the most universal truth at which human reason has yet arrived," and of the nature of which, save as to its effects, we know absolutely nothing. What is this immeasurably vast and all-pervading

power which binds the moon to the earth, the earth and other planets to the sun, and the solar system itself to some immeasurably distant star? which may again be but the satellite of some yet grander centre, sending out its power from some inconceivable distance, which no mortal eye can scan, and mortal sense scarce conceive! What are these "Meteor Showers" which we saw so visibly in November, 1868, and again in 1869, and which, it appears, we are to expect at regular intervals? We have advanced so far as to know there are, probably, many belts or zones of meteors revolving with mathematical regularity within the limits of our planetary system; but what are they? What is their object? and what is their composition?—we don't know. That wonderful discovery, Spectrum Analysis, *hints* darkly at incandescent Hydrogen Gas, but nothing more! I fear I am straying from the immediate objects of our Society, but it is such a tempting subject for speculation. The past year has been by no means an eventful one for new discoveries; indeed, we seem to have arrived at one of the pauses or halting-places of Science, where discovery takes breath for fresh exertions, for all scientific progress is very intermittent and fitful. We are very apt to talk of the wonderful progress Science has made in our time, and to be rather disappointed if each recurring year does not produce some fresh marvel; but our modern times, especially the last half century have been remarkable rather for the elaboration, the perfection, and utilisation of ideas than for aught else. Electricity and the magnet were known 3,000 years ago to the Greeks, though they have but recently resulted in the Electric Telegraph and Mariners' Compass. The extensive powers of steam were known to the ancients; and modern Chemistry, with its many wonders, is but the Alchemy of the Dark Ages. So we must be content to work on, each contributing his mite towards the elucidation of existing mysteries. What a vast field for speculation and interest is opened up by the pursuit of Natural History! How by its aid we find life and interest in the most unexpected places, for to the Naturalist all around teems with life. At the bottom of the Atlantic, in depths varying from 2,000 to 3,000 feet, we still find life, for here dwell countless molluscs, corallines, &c., though how organic beings can exist while sustaining so enormous a pressure,

as must be caused by so vast a column of water, remains a mystery! From the result of deep sea sonndings and dredgings it appears that the entire sea bottom is positively coated with a layer of living jelly which, probably, forms food for more highly organised life, but which can itself obtain nourishment only from mineral sources. The everlasting snow of the North Pole still sustains life, both animal and vegetable, and the part that is, perhaps, the most destititute of living creatures, is, where at first sight we should most expect them, in some of the tropical parts of South America, where exist burning arid deserts, apparently quite devoid of organic life. "Here," says Darwin, "I saw neither bird, quadruped, reptile, nor insect, except the vulture, which preys on the carcases of the unfortunate mules which have perished of fatigue in attempting to cross the desert." Even the very air we breathe is peopled with minute dust composed of infusorial life, and that in regions, where we should least expect it. Far away at sea, 1,500 or 1,600 miles away from shore Professor Ehrenberg discovered no less than 67 different kinds of infusoria in five little specimens of thin microscopic dust. How these living forms are generated is a marvel of science. Some say from spontaneous generation, though it is contrary to all our ideas that any living being can spring into existence of itself, and yet they are generated and live in solutions of organic matter which have been put in hermetically sealed flasks and submitted to a boiling temperature for upwards of 4 hours. You would think no germs of life could survive after such a boiling as this! And yet we know that not only some water weeds, but even fish will live, and apparently enjoy life, in water so hot that it would actually *boil* them if dead! Many fish will live in water so hot that it is impossible to bear the hand in it, and Humboldt saw living fishes thrown up from a crater in South America, in water whose temperature was 210°, only 2 degrees less than boiling! I have before alluded to those tiny living atoms called Diatoms, each measuring from $\frac{1}{5,000}$ to $\frac{1}{1,000}$ of an inch, and which yet exist or existed in such vast myriads as to form no inconceivable portion of the earth's surface. Some recent discoveries have revealed the curious fact that there exists a rather extensive list of animals inhabiting vast gloomy caves and cells, which are perfectly without any vestiges of eyes!

these animals are principally Rats, Beetles of various species, Bats and Crustaceans. Now I need hardly remind you, that although Bats and Beetles were once popularly supposed to be blind, it was only a vulgar delusion, and consequently the connection of these blind animals with the outer world becomes of extreme interest, in connection with Darwin's theories as to the origin of species. His idea is that their ancestors wandered into these caverns in remote ages, that generation after generation was born and died without ever seeing light, so that the disuse of the organs of sight gradually led to their entire suppression, and this seems the more reasonable because one kind of rat was discovered, which though quite blind in the daylight, had eyes which were enormously developed and with which it could very probably see in the dark, while others had the optic nerve developed, though there was no vestige of external eye, and some of the beetles had their antennæ enormously developed, as though to compensate for the loss of vision. The whole theory of the origin of species is one of enthralling interest. We all know that many animals existed in remote ages, which have no representatives now; but we scarcely reflect that in this our day species are dying off the face of the earth, several even have become extinct during the last 20 years, and Gosse estimates the loss in this way at no less than one species for every year. Thus it would appear that species have their allotted time for existence, just as individuals have theirs,—thus a Fly may have a span of life for a few days, a Raven or an Elephant of almost centuries—so the species of Irish Elk, or the species of the Mastodon may have reached their allotted span in the Tertiary Era; whereas that of the Dodo, the Great Auk, &c. may have expired only recently, and that of the Wolf, Beaver, &c. may be quickly approaching. The question then arises are fresh species being created? Are some of our newly discovered animals really only newly created? We know that with individuals the death-rate is pretty nearly counterbalanced by births. Does this law hold good with species? How many are and have been for ages extinct? There was the huge Dinotherium that wandered in the half-drained Swiss valleys and in the swamps of Germany, a monster larger than the largest Elephant, a body 20 feet long and legs 10 feet high; a head something like that of

an Elephant, but with a shorter proboscis and down-curving tusks like pickaxes to dig up succulent roots. On the Himalayas roamed another vast nondescript, something between a Rhinoceros and an Elephant, with two pairs of vast horns, one somewhat like an Ox, and the other pair vast and branching like the Fallow Deer. A vast land Tortoise too existed, measuring some 30 feet from head to tail, and wandered through the primeval forests, beating down roads as broad as our highways as he walked. A vast two-horned Rhinoceros roamed on the plains bordering the Arctic Ocean, and the Mammoth, a sort of hairy elephant, existed in the same cold regions; nor must we forget the Mastodon, of which vast numbers must have existed, an animal elephantine in appearance, but with a body longer and legs shorter and stouter. Then there was the Megatherium, which Professor Owen so well describes, how it reared its vast bulk on end, aud after digging round the base, would embrace some vast forest tree and wrestle with it till it fell. How strange it is to reflect that here in England, where now London stands, with its miles of houses and countless throng of busy men, amid wild primeval forests roved the vast Dinotherium and Mastodon, while Hippopotami and Rhinoceroses wallowed in the adjacent swamps, and gigantic Oxen and Stags, Reindeer, long-tusked Mammoths, and two or three different species of Horses browsed around. Still more diffieult is it to imagine in this now peaceful land, that the Lion and Tiger once held sway among these vast but harmless animals, and that the Machairodon, a vast and bloodthirsty animal, larger and fiercer than the Bengal Tiger, with curved and saw-edged teeth, preyed on the peaceful stags and oxen. In this favored isle also existed vast and ferocious Bears and gigantic Hyænas, whose bones are still found surrounded by the crushed and gnawed bones of their last victims. How wonderful to reflect that all these particulars can be gleaned from what I have heard spoken of, contemptuously, as "a parcel of old dried bones!" and yet a man, like Professor Owen, from a single fossil bone, will give you a whole history of species, shape, size, and habits of some long extinct animal; and M. Dupont has written a most interesting book "On the People of the Reindeer Age" (that is, the period before the Reindeer retreated to his present quarter, in the north of Europe, and while he

still roved the south of Europe), in which he familiarly describes their diseases—their tastes; for example, their love of curiosities, as evinced by fossil collections of shells, &c.; their warlike habits, as evinced by the skeletons of men not being found in the same proportion as the women who died at home; and he talks of their industry, superstition, and respect for the dead, all of which he infers from circumstances connected with either the position or material of the objects found in the caves; and this brings us to the much debated question, Was man co-existent with any, and if so, with which of the extinct animals? Geologists have hitherto held that man was a subsequent creation, but many facts have recently come to light, which if they do not carry the existence of man farther back in the vista of years, certainly bring the existence of extinct fossil animals farther towards our own time. It is not many years since a Mammoth was discovered in arctic Russia frozen up in a mass of ice, not only in a fossil condition, but with flesh on his enormous bones, tufts of coarse reddish hair and bristles on his hard leathery skin, and even the eyes perfect. The Mastodon has been discovered in America, associated with some of those mysterious remains of human work in some far far off age, and it has even been suggested that these vast marvels were used as beasts of burden to carry some of the ingeniously carved masses which are occasionally found, though I must confess a Mastodon with a packsaddle, or a Mammoth with a crupper, are quite opposed to all one's notions of the dignity of the primeval giants! The extinct Irish Elk has been discovered in Ireland, not only associated with men's bones, but with holes in the forehead, evidently caused by some fossil butcher's axe, and at Wexford some remains of the Elk were discovered in so recent a condition that the Royal Dublin Soeiety made soup of the bones, whether they enjoyed it I can't say, but it appears rather an Irish method of pursuing a Scientific investigation! But then if, as we are told by some recent investigators, man existed in a state of civilization in the Nile valley 13,500 years ago, what are we to think? All our preconceived ideas of the age of the world are upset, and we can only reflect how very little we know, for certain, on any subject. I spoke, just now, of the *air* teeming with life, but Natural History teaches us that the *sea* is sometimes literally converted into a living mass.

We all know the phosphorescent appearance of sea water when it appears like liquid fire, and no doubt you are all aware this is caused by minute jelly-like animalcules, and Darwin records how when the vessel was on the coast of Chili, it passed through bands of reddish coloured water, which when microscopically examined, consisted of minute animalcules; they were so minute as to be invisible to the naked eye, and yet they passed through many successive miles of them. How inconceivable then must have been their numbers? In parts of the Arctic Ocean the water is coloured an opaque green, owing to the presence of countless myriads of minute Medusæ. Scoresby calculates that in a space of two square miles there would be congregated together a number, which 80,000 persons, counting incessantly from the creation until now, would not have enumerated, though they worked at the rate of one million a week! Even man, the lord of creation, is not free from a rather unpleasant redundancy of life within his organs, but as this is not a very pleasant subject, I will not pursue it, further than to caution you against eating underdone meat, especially pork, lest you introduce the germs of numerous living parasites into your internal system! Many of you saw the Singing Mouse, exhibited by one of our members. This curious phenomenon is caused by spasmodic breathing, due to the presence of a parasite, the *Cystercus fascicularis;* though really the Rodents are so birdlike in many of their habits and structural character, that we might hardly be surprised if they all sang, for why *do* birds sing? It is quite a mistake to believe all birds sing, the vast majority do not, and it is difficult to imagine why many of them do, or how they are thereby benefited in their struggle for existence. The whole subject of Parasites is a curious, if not a very inviting one for investigation, so I think I cannot better conclude than by a quotation from Tom Hood's humourous notion on the subject:

> Great fleas have little fleas upon their backs to bite 'em,
> And little fleas have lesser fleas, and so *ad infinitum.*

I fear I have now trespassed far too long upon your time, but if I have only persuaded some of you that the pursuit of Natural History is not altogether devoid of interest and amusement, I feel I shall not have spoken quite in vain.

After a short discussion the Secretary was called upon to read

the Balance Sheet, which showed an amount of £3 10s. 11d. in favour of the Society. A report of the proceedings of the past year followed, of which we give a summary.

Eight evening Meetings and three Field Days had been held. At one of the former a specimen of *Deiopeia pulchella*, the Crimson Speckled moth, was shown on the setting board, captured by T. H. Briggs, Esq., in the immediate neighbourhood of Folkestone.

Papers had been read on the following subjects:

The Geology of the Locality .	H. B. Mackeson, F.G.S.
On Mammalian Skulls . . .	Rev. E. Langdon, F.G.S.
On Sticklebacks	C. E. Fitzgerald, M.D.
Land Shells	Rev. E. Langdon, F.G.S.
Tour in Shetland	Rev. C. L. Acland, M.A.
Local Rare Plants, read for .	Mrs. FitzGerald.
Natural Selection	Rev. C. L. Acland, M.A.

A series of Mammalian Skulls had been presented to the Society, by the Rev E. Langdon. A list of Folkestone Lepidoptera, by H. G. Knaggs, M.D., F.L.S., had been published by the Society.

A series of Public Lectures, had been commenced, and a class formed for instruction in Botany.

C. H. Dashwood, Esq., F.Z.S., then read a paper on the Migration of Birds, prefaced by special remarks on the structure of the wing, and this was followed by a paper on

Peruvian Antiquities, by the Rev. C. L. Acland, illustrated by a collection lately brought from an ancient burial ground in Peru.

Thursday, March 3rd,

Conversazione at the Town Hall. The following Paper was read by the Secretary:

ON PRIMROSES AND THEIR FERTILIZATION.

> A Primrose by the river's brim,
> A yellow primrose was to him,
> 'Twas that and nothing more.

I have chosen this quotation simply because it is not all suitable for the object we have in hand, nor to be taken as a

motto by the members of a Natural History Society. Yet it is doubtless known to you all, and may serve as a "shocking example" of the state into which some people fall, who neglect to use their senses. Much more than simple "yellow primroses" are these blossoms to us. I might enlarge upon them as the flowers of childhood, round which cluster many "sunny memories" of our early days, that might otherwise have been forgotten; as members of the happy careless hours when earth was ever unfolding new treasures and filling our minds with delight at its luxuriousness of beauty—the

"Time when, meadow, grove, and stream,
The earth, and every common sight,
To us did seem,
Apparelled in celestial light,
The glory and the freshness of a dream.

And again I might dwell upon them as above all others the flowers of spring, bright aud happy messengers, coming with clear blue skies in January and February to tell us of the wealth of form and colour that will shortly dazzle our eyes as the bleak days get fewer, and at last disappear. But this would be too sentimental; we must look deeper into Nature than this, and derive a still greater intellectual feast from a knowledge of the mysteries of life that lie hidden in the Primrose. We discover at once, from the venation of the leaves, that the Primrose belongs to the exogenous order of plants, these veins forming a network all over the leaf, and not running parallel from one end to the other, like those in a lily leaf. We notice, moreover, that there is no *peduncle* or stem here: you may express surprise at this, seeing so many blossoms springing up from the root, each one at the head of a stalk. But these stalks are *pedicels* or secondary flower stalks, like those which spring from the head of a Cowslip stalk, and if you cut through a root just below where it emerges from the ground, you will notice that all these pedicels spring from one circling line marking the real stem, which in this case, is to a certain extent *suppressed*, or rather *arrested* in its growth. Occasionally, owing to certain circumstances, this peduncle shoots up to some height, carrying the pedicels with it; then we get the variety commonly called the Oxlip, though not the true species of that name. To this I shall refer again presently.

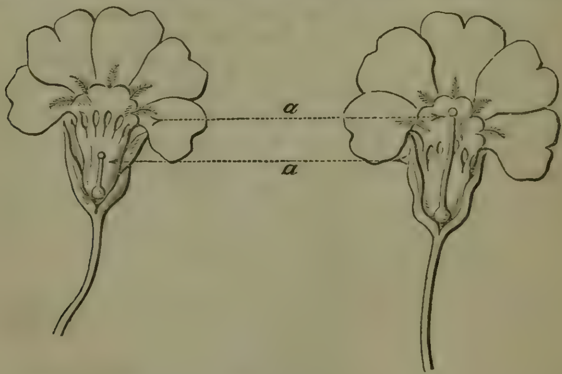
And now ascending the stalk we come to this green cup at the summit, which all the members of the botanical class will recognise as the calyx. The component parts of this calyx, i.e. the *sepals*, are five in number: that or some multiple of it, as you know, is the prevailing number of organs in this division of plants, though four shares the honour to some extent. But you do not find that these sepals are separate as in the case of the Rose, nor deciduous as with the Buttercup; they are all united, hence the calyx is *gamosepalous*, and it encloses the seed vessel until its contents are perfected, hence it is *persistent*. You recognise the five sepals, however, by the five points at the summit.

Inside this calyx we come to the five coloured leaves or petals forming the *corolla*, and these likewise are united—*gamopetalous*. Concerning the colour of these petals Naturalists are divided, though it is highly probable that many of us have no doubts on the subject; but if you gather numbers of blossoms from different localities, you will find them varying from light yellow to yellowish green, and in some parts of England they are decidedly pink. Some call the colour green because it turns green when dried, but that seems to me an absurd reason; this dried cowslip is blue, but I do not suppose anyone would talk of blue cowslips. Inside the corolla again we come to the stamens five in number; and here mark a peculiarity. It is another general rule in the arrangement of the organs of the flower, that each member of a circle of organs is inserted opposite to the *opening*, between two members of an outer or inner circle; e.g. each petal is inserted between two sepals, though inside, each stamen between two petals and so on. But here, as you see, the stamens are inserted upon the petals (hence styled *epipetalous*) and opposite to each—not between them; in a case like this it is considered that an outer circle of stamens has been suppressed, and hence the members of this second and inner circle come between where the others would have been.

Having stripped off the calyx, the corolla, and the stamens we come to one solitary organ in the middle—the seed-bearing organ or *pistil*, with the *stigma* at the summit.

Here I come to, perhaps, the most interesting portion of my paper, a peculiar feature in the physiology of the Primrose. Those of us who have been in the habit of not merely gathering flowers but also of examining them, must have

noticed that in some flowers of the Primrose there is a small spherical body, a little larger, perhaps, than a pin's head, in the centre; that in others this organ is invisible, and instead we have deeply hued yellow bodies, five in number, clustering together. These two varieties of the primrose are known respectively as *pin centres* and *rose centres;* the same peculiarity being observable in Cowslips and the garden Polyanthus. The rose centre is accounted the more handsome of the two and is cultivated to the exclusion of the pin centre. Now what are these organs? The little round body in the pin centred specimens is the *stigma,* i.e. the summit of the *pistil,* or seed-producing organ; the "rose centres" present us with the *anthers,* or pollen-bearing organs at the summit of the stamens. But if you take a rose centred specimen and dissect it, you will find the pistil inside, but reduced to about half the length, thus allowing the stamens to tower above it. So if you dissect a pin centre you will find stamens below. Such are the *facts* to be gleaned by simple observation; what I have to say now will show what is to be learned by thought and careful scrutiny from these facts. You all know that no seed ever arrives at perfection without the pistil being fertilized by pollen scattered on it from the anthers. Now what follows from this? By the aid of the illustration I hope to make it plain.



We are indebted for the illustration to the courtesy of the Editor of the *Field Quarterly.*

Here then we have a short-styled variety on the left, the anthers reaching some height above the stigma; it is easy enough to imagine how the pollen may drop from these anthers on the stigma and so fertilize it. But what about this long-styled pin centre on the right, where the stigma stands above the pollen bearing organs, and so does not stand any chance of being fertilized? Now the first thought that struck Mr. Darwin was this, that the Primrose was gradually becoming *diœcious*, i.e. that by and by the stamens would die out in the long-styled specimens, and the plant would bear only a pistil; and that in the short styled specimens the pistil was dying out and the stamens were developing themselves. It is the case in many plants that some flowers bear pistils only and others stamens only—they are called *diœcious* or "*two*-housed." Thus in time we should get two sorts of primroses much more distinct than they are at present. Again, the thought may strike you at once, that if the pollen cannot reach the stigma on the long-styled specimens there can be no fertilization, and therefore no seed, and consequently the pin centres must in time die out. Now we must ask some botanical friend whether he knows for a certainty that the pin centres ever produce seed. He says "Yes, quite as often as the others." Therefore they do get fertilized. This sets us thinking again—how? Mr. Darwin says it is done by the Humble Bee. Many of you will recollect how by the agency of this and other insects orchids are fertilized. The bee inserting its head into the corolla of a flower detaches some of the pollen, and upon entering another is pretty certain to leave some of it behind. It is now a well-known fact that this process, which is called cross-fertilisation, is the rule and not the exception; the exceptions lie on the other side, the case of a flower fertilizing itself by its own pollen, being rare even in flowers like the short-styled primroses. And when such self-fertilization takes places the seed deteriorates.

But then you will say in a case like this—the short-styled Primrose—how is it possible to prevent self-fertilization? Now we make use of another or two of Mr. Darwin's discoveries in the physiology of plants. He discovered that when a stigma is covered with two or three kinds of pollen,—species or varieties, one only takes effect to the exclusion of all others; also that the pollen from a long-styled Primrose is more

powerful on the stigma of a short-styled specimen than its own, and *vice versa :* hence if the stigma in a rose centre gets sprinkled with pollen, both from its own anthers and from those of a pin centre, the latter will be most probably the effectual agent; and if the stigma in a pin centre receives pollen by any means from its own anthers (which is unlikely) or from another pin centre, the latter only will take effect. Hence a cross fertilization goes on, and this you see by agency of insects. It may not have struck you, could not in fact, unless some of these facts were known to you, that insects and flowers are mutually necessary to each other, and neither could exist without the other. I remember being muck struck with this remark when I heard it from the lips of Mr. Bates, the traveller of the Amazons, during a short walk on the Warren. "If insects perish" he said "flowers must necessarily perish too." The flower yields its nectar to the insect, and the insect in return assists in perpetuating the flower.

Such are a few of the mysteries enveloped in a Primrose blossom. As my remarks have already reached a greater length than I intended, I must say nothing about the Cowslip, though I should like, if I am not tiring you, to say a few words about the *Oxlip*. I may astonish you, but I do not think I shall make a rash assertion, if I say that, in all probability, none here present have seen the true Oxlip. It grows in Cambridgeshire and perhaps one or two other localities. What we call the Oxlip is, as you know, a set of several flowers like Primroses growing on one stem like Cowslip flowers. I remarked a few minutes ago that the stem of the Primrose was arrested in its growth, that if you cut through the root just below the ground you would see that the pedicels all sprang from one circle, and that if we could only imagine the stem elevated, carrying this circle with it, we should have our Oxlip. It has been generally set down as a hybrid between a Cowslip and a Primrose, but I am quite of the opinion of my friend, Mr. Britten, (to whom I am in fact indebted for some of the thoughts I have placed before you,) that it is but a developed Primrose. He has found both single flowered and many flowered stems growing on the same root. It is a question, however, by no means settled, whether there is not in addition a true intermediate form between a Cowslip and a Primrose. There is plenty of work before us all in the matter

if we like to commence the work of observation. I chose the subject because I thought it might give us all an object to work for at once, as the Primroses are now coming out. I give you a hint or two about it. Set notes down in your vade-mecum (I suppose no member of a Natural History Society goes out without a note-book) to work out answers to the following questions:—

1. Are these oxlips most plentiful among primroses or among cowslips?
2. Do those which occur among primroses bear a closer resemblance to primroses than to cowslips?
3. Do those among cowslips resemble those flowers most?
4. Have you ever found primroses and oxlips on the same root?
5. Have you ever found cowslips and oxlips on the same root?

In all probability the Primrose, Cowslip, and Oxlip are not distinct species, but have been developed from one common form, according to surrounding circumstances.

Wednesday, April 27th,

Conversazione at the Town Hall. On the table were collections of Dried British Plants, and also from the Arctic Regions. The following Paper on the latter was read by the President:

ARCTIC BOTANY.

I propose this evening to say a few words on the effects of temperature in modifying the growth and external characteristics of plants. You are, most of you, I think, aware that I made a voyage some 13 or 14 ago to the North Pole, with Lord Dufferin, an account of which he subsequently published. I am not, to-night, going into any account of that voyage, or of the many points which might, perhaps, be interesting to us as Naturalists; this I propose to do, with your permission, on some future occasion, when in the form of a Lecture I may call your attentlon, not only to the Fauna and Flora of the extreme North, but to the manners and customs of the natives, some of them sufficiently primitive, which may prove

interesting to us as Ethnologists. The specimens you see before you on the table were collected by me during the voyage to which I have alluded, and I intend, at present, merely to call your attention to the external differences you will perceive between them and their representatives which have been grown in a more southern latitude. I am not going deeply into this subject. I have often said that if each lecturer, or author of a paper, were content to impress one single point on the memory of his hearers, he would do more good than by entering into the more abstruse details, which are so hard to avoid. Now the point I want to impress on you to-night is the very marked difference in size which occurs in plants when they are grown in very high latitudes, or what is nearly the same thing, at great heights above the sea-level. As you all know, whether you recede farther and farther from the equator, or whether you ascend higher and higher above the sea level, either in a balloon or up the sides of a mountain, the result is the same, a steady decrease of temperature, and thus we have the Flora of high mountain ranges, closely coinciding with that of the extreme poles. As the cold increases vegetation becomes less and less luxuriant; ferns diminish in size, and finally disappear; trees dwindle down till only the hardy white Birch and the Pine remain, which after pushihg out an advanced guard as far as 70 degrees North latitude in Norway completely disappear and give place to grasses, and finally to cryptograms (mosses), lichens, and microscopic fungi. Many of the specimens before you are from Spitzbergen, the farthest north of any known land. A wild, vast, bleak island, perpetually hemmed in by ice, save where the genial influences of the Gulf Stream thaw it away—on tis western and southern coasts. A region almost entirely covered in perpetual ice and snow—where human life is impossible, and where the ground, in even the most favored localities, is never thawed deeper than two inches below its surface. Here then is the most advanced outpost of organic life, beyond stretches only a death-like expanse of dreary ice. (Spitzbergen is not, you must recollect, the tiny spot of earth one usually sees represented on the maps; it extends over 10 degrees of latitude, and is in consequence larger than Ireland or even England). When I remind you that there is total night in Spitzbergen for four

months, and that during four more the sun rises for only a very short period above the horizon; that during this long winter mercury freezes and the human breath falls in snow flakes through the air; that the ground is almost entirely covered with perpetual snow, even in Summer, and where it is exposed, is of an icy hardness, it seems almost ridiculous to talk of the "Flowers of Spitzbergen," and yet you see, flowers there are. We were there in the very warmest part of the year—August, when, as you know, there is constant daylight, and yet even at the hottest portion of the day the thermometer never rose as high as the freezing point. For you must remember, although to counterbalance the long eight months of winter the sun never goes below the horizon for four months of summer, yet his rays penetrate so vast a thickness of the atmosphere, and finally strike the surface so obliquely that they have very little heating properties left. I need scarcely say there are no water plants in Spitzbergen, for the simple reason that there are no rivers or brooks; the nearest approach being a tiny trickling from the vast glaciers which occupy every valley, and end abruptly at the sea. Very grand objects these glaciers are. You may get some idea of them from this sketch I made from the sea, representing their appearance at the distance of 8 or 10 miles. You would suppose, from their appearance that they are much nearer, but this is in consequence of the extreme and curious transparency of the arctic atmosphere, which is most deceptive, as I remember to my cost; for one night being becalmed at a distance of (as we supposed) 5 or 6 miles, Lord Dufferin and myself started in the small boat to pull ashore. In turn we pulled and pulled for several hours without apparently getting any nearer; our pride would not allow us to return on board, and we had to row the entire night before reaching the shore, which proved to be some 30 miles off, and to increase our mortification, just as we were preparing to land—our arms and necks bitten with mosquitoes—the yacht quietly glided past us into a little creek, and we could not fail to perceive the grin of enjoyment of the men at our manifest discomfiture. The spot my sketch represents is called the Seven Glaciers, and it presents a magnificent appearance from the sea. It appears as though seven gigantic rivers were suddenly arrested in their foaming and tumultous course and stricken into ice; the abrupt surface

towards the sea measures about 500 feet, and I can scarcely recall anything more trying to the nerves than an hour I once spent on one of them while in solitary pursuit of a Bear, whose footprints I had tracked in the snow. The vast perpendicular fissures with their glistening sides of azure ice, which one had to jump or climb across, were calculated to suggest unpleasant ideas of the effect of a slip or a false step; and the terrific reports, like the booming of a thousand cannon, made one fancy that the whole mass was being rent. These glaciers are of great interest to the Geologist, giving an idea of how England must have looked during the Glacial Epoch; indeed the entire appearance of Spitbergen gives one a very fair representation of the Glacial period which immediately preceded our present one, when the whole of North Europe, as far as 58° of north latitude, was more or less entirely enveloped in ice. One's first impression on landing in Spitzbergen is one of utter desolation—of bleak death; no blade of verdure gladdening the eye; no sound of life greets the ear; all around is the silence of the tomb. One might imagine oneself in an extinct world. It is only after a close investigation that signs of vegetation can be detected—here a hardy moss ; on the dark grey rocks a yellow lichen, while nestled under some sheltering stone may be found the downy *Cerastium alpinum* (Mountain Chickweed), or the tiny bright yellowed *Dryas octopetala* (Mountain Avens); while in favoured spots, frequented by seabirds, may be found the *Ranunculus*, *Cochlearia*, several grasses, and occasionally the Yellow Poppy (*Papaver nudicale*). The only plant at all approaching the character of a tree is the *Salix reticulata*, one of the smallest of the Willow genus; this tiny plant also grows high up on the Alps, and I may here remark that while plants collected at places just about the Arctic circle, such as Hammerfest, North of Iceland, &c., will be found to correspond with those just below the line of perpetual snow on the Alps and Pyrenees, those found in Spitzbergen correspond with Alpine plants *above* that line. The remaining plants are mostly of very minute size, and have to be very closely searched for; thus it was for a long time imagined that the flora of Spitzbergen consisted only of mosses and about half a dozen flowering plants, but this number has been gradually increased by successful voyagers, until it has reached the

imposing number of 93 flowering plants and 152 cryptogams (mosses and lichens), which resist the most vigorous cold; making a total of 245. Now 93 flowering plants may, perhaps, strike you as being rather numerous; but I would remind you that Iceland with its bleak climate, though far less in extent than Spitzbergen, numbers 402 species, while Ireland, again still smaller, boasts 960 flowering plants.

I am not going to weary you with a catalogue of the names of the Spitzbergen plants, suffice it to say, that as in all Northern regions, they consist chiefly of the *Graminaceæ* (grasses), *Cruciferæ*, *Caryophyllaceæ* (pink family), *Saxifragaceæ*, and amongst the genera we find *Draba* (Willow Grass), *Saxifraga*, *Ranunculus*, *Carex* (Sedge), *Poa* (Meadow Grass). They are all necessarily perennial,—I say *necessarily*, because it would be impossible for any annual long to survive in so bleak a district, as a failure in any one year would lead to its utter destruction. You will find that while the Norwegian specimens are smaller than English plants of the same nature, that the Icelandic are smaller than the Norwegian, and the Spitzbergen again are smaller than the Icelandic. Among the Spitzbergen specimens you will find several Saxifrages, one of which *(Saxifraga Cernua)* I found under somewhat peculiar circumstances. I was wandering away from my companions with my rifle, in search of reindeer, and found myself in a gloomy valley, surrounded with black and jagged rocks; all around a deathlike silence reigned, and as I wandered on, unconsciously impressed with the solemnity of the scene, but with my thoughts hundreds of miles away, I came suddenly on an open coffin of bleached and mouldering wood, within which lay stretched the whitened skeleton of a man; a rough deal cross was at his head, on which was an almost obliterated inscription in Dutch, of which I could just decipher enough to learn that I was looking on the remains of one Jacob Moore, who had died in 1726, and who had, doubtless, been one of the crew of some last century whaler, whose shipmates had given him the only burial in their power, by leaving him in his coffin on this inhospitable shore, where the ground is so hardened with ice, that even in Summer it is impossible to dig three inches into its frosty surface. Within the coffin and peeping out between the whitened bones, grew this tiny graceful flowering Saxifrage!

Saturday, May 14th,

FIELD DAY. Members were met at the Tower on Sandgate Plain by H. B. Mackeson, F.G.S., who gave an interesting and instructive field Lecture on the "Geology and Botany of the Locality," conducting them as far as the Turnpike Gate in the Lower Road.

Saturday, June 25th,

FIELD DAY at Lydden Spout. Members proceeded by the 2.35 local train to Lydden Spout, where the train was allowed to stop for them to alight, by the courtesy of the South-Eastern Railway Company. There was a very large attendance, and many visitors were present. The spot is a most attractive one, lying immediately at the foot of the chalk cliffs, which are here about 500 feet in height. There is a considerable amount of broken ground or "undercliff" in the neighbourhood, which formed a very satisfactory hunting-ground both to the Botanists and Entomologists: rarities being found by both sections. The spot derives its name from a cool, clear spring of delicious water issuing in large volume from the face of the cliff.

Papers were read by the President on "British Snakes," and by the Secretary on "Clear Wings." The following Paper had been prepared by the Rev. C. L. Acland, and though time would not allow of its being read, we feel sure the Members will be glad to see it now:

ON THE SPECIAL CHARACTERISTICS OF SEA-SIDE PLANTS.

"Leaves glaucous, fleshy; flowers inconspicuous, or blu*ish*, green*ish*, whit*ish*, as the case may be."

Anyone knowing much of the nature of plants would expect to find the specific term "maritima" belonging to the one whose description ran as above, that is to say, would expect that the plants answering to this description grew near the sea. Of course I do not mean to say either that all plants growing near the sea are glaucous and fleshy, or that all glaucous and

fleshy plants grow near the sea, but I think I may fairly say that our *characteristic* sea-side plants are glaucous and fleshy, almost without exception.

First, what is "glaucous." It is a *colour* at once difficult to describe, and impossible to mistake if once seen. Babington defines it as "green with a whit*ish*-blue lustre," and Balfour as "covered with a pale green bloom." Most of us can now recall the colour, and if not, we must try to find some plant which will teach us, once for all, the nature of this most characteristic hue. *Glaucium luteum*, the Yellow-Horned Poppy, a very noteworthy sea-side plant, is likely to be the first you will find here, and takes its generic name from the prevailing colour of the plant. Sea Purslane, Sea Holly, and Sea Gromwell are also fine examples of the same colour.

"Fleshy" needs less explanation, as the *Samphire* we may gather here will at once occur to you all as an example. You will find the leaves of the *Horned Poppy* also very fleshy, and the others I mentioned just now illustrate the same peculiarity.

Now with regard to the flowers, which as I said, are inconspicuous, or this-that-or-the-other-*ish*. My example of the Horned Poppy does not fail us here, though it illustrates the other properties better. The yellow is rather too vivid to be -*ished*; but it contrasts badly with the intense yellow of the buttercup, or the decided pale yellow of the primrose. But the Samphire, the Sea-Holly, the Sea-Campion, and the Sea-Gromwell, with many others, have flowers whose colours look faded or as if seen through a fog, or perhaps still more perfectly, like the surface of a freshly gathered plum when the beauty of its purple sides is at once exalted and depressed by the presence of the *bloom*. Sometimes as is the case with the Sea-Purslane and Sea-Campion, the whole plant appears as if dusted over with a whitish powder.

And again, as regards their attachment to the soil. You will generally find with the decidedly sea-side plants, that this is one of two forms. Either by a very strong deep tap-root, often ludicrously disproportioned to the size of the plant belonging to it, as you may easily find out for yourselves in the case of a youngish specimen of the Horned-Poppy, or else by a number of short, and rather thin, but strong fibres. This last form chiefly obtains in the plants of salt marshes, but is not exclusively appropriated by them. In the

first case we may suppose that the tap-root pierces down to some substratum of moisture, whence the plant may obtain part of its nourishment; but in the latter the fibres often appear to be anchors by which the plant is prevented from being blown away—with which view, also, no doubt, the whole plant is frequently procumbent, or lying flat upon the ground to an extraordinary extent, so that sometimes we find many square feet of soil, if soil it deserves to be called, covered by a dense mat of vegetation formed by a single plant.

Once more, several of these sea-side plants are marked by strong (often aromatic) flavours. Samphire, for example, has a flavour utterly unlike anything else, about which tastes differ, but of which I own to being very fond. The same is the case with Fennel, Asparagus, and Celery, all of which are found *wild* only on the sea-coasts—the first and last of them falling within our range. The Sea-Gromwell, which I have more than once mentioned, and which is the model of a sea-side plant, presenting in perfection all the characters I have mentioned, tastes strongly and unmistakeably of oysters. Indeed in Shetland, upon the stony shores of which, in Colafirth Voe, I had the pleasure of finding it last year, it is called the Oyster-plant. I saw specimens of it more than six feet long, and in no part as much as two inches from the ground. With its thick mass of glaucous fleshy leaves and terminal many-flowered cymes of pale blue flowers, it is as striking a plant as I have ever seen. I very much wish I had the chance of shewing it to you to-day. That, however, is out of the question, so if you wish to see it you must go, as I did, to Shetland. There too you may chance to find the Norway Sand-Wort, *Arenaria Norwegica*, another, but very small, fleshy sea-side plant; one of the few surviving remnants of the Arctic Flora which once spread far and wide over our Northern hill-sides, but which lingers only on the tops of our loftiest mountains, or on the extreme shores of our Northernmost islands.

Such are the principal external characteristics of these sea-side plants, and I strongly recommend you not to take them for granted, but to verify them for yourselves upon such of these plants as you may come across. Many of them grow within the five mile radius, and therefore, all fairly under the investigation of our Society, and one fact learned or verified

by your own observation is worth 50 taken on trust from books, or picked up by listening to a paper like this. I shall be glad to supply you with names and localities of our maritime plants.

Many, if not most, of these fleshy sea-side plants contain iodine, and also large quantities of various salts of soda. Some few of them, as Thrift, Sea-Plaintain, and Scurvy-grass are also found inland, in which case they are at or near the summits of our highest mountains. In this latter situation these plants, instead of the salts of soda, contain salts of potash. These salt-containing plants are so distinctly marked that the Greek compound *Halophytes*, or salt plants, has been formed for them.

Now I think there can be no doubt that in some way or the other—often not understood by us in our present state of the knowledge—these peculiarities are efforts on the part of our plants at accommodating themselves to circumstances. When, for example, we consider the case of Samphire growing in apparently barren chinks in the face of the chalk cliff, or rooted deep in the still more barren flint shingle; or of the Sea-Campion growing also on the shingle; or of the Sea-Gromwell on the utterly bare shores of our most Northern coasts, and find them all fine healthy plants, we see that they must possess some power of picking up a right good living where almost all plants would certainly starve. They have but little soil to trust to, and that little is always either very poor or very salt, and in either case unfavourable to the free developement of vegetable life. Accordingly they must get most of their sustenance from the air, and but little from the ground in which they grow. On the driest and most parched parts of the globe we find, as in the deserts of Africa, vegetation, and of what nature? Cactus, or cactus-like plants without exception—that is, once more, fleshy and unusually glaucous plants. Now in the case of these latter it is obvious that all the food they get must be from the air, and so it is no doubt with our sea-side plants.

I had once a plant of the Cactus kind, *Crassula sulcata*, a plant I have often seen in windows in Folkestone, and it continued to flower long after the whole lower part of the plant was entirely dead. When I examined it I found at the bottom of the still living portion of the plant a little whorl of fibre

like roots, which had shot out into the air, and were not less than six inches from the ground, which, however, they made no effort to reach. They did not increase in length, shewing that their function was to hold the plant in its place, and that this function being already performed by the dead stem there was no need for them to grow longer. Why the fleshy nature of the leaves peculiarly fits the plant for a barren soil and a salt air is not so easily determined; partly, probably, by the abundant supply of moisture thus contained—as in the stomach of the camel—within the plant itself, rendering it independent of the moisture of the soil, and partly by increasing the power of secreting from the air the carbonic acid, to which, decomposed as it is in plants by the agency of light alone, the woody constituents of the plant have to look for their sustenance.

The presence of iodine and of the salts of soda in sea-side plants is accounted for by their neighbourhood to the sea, the great source of both, and the absence of these in such as grow at the tops of mountains is similarly explained. But apparently these *Halophytes* cannot do without salt, so not being able to get soda from the sea, they take potash from the land, and thrive upon that. The procumbent growth of the plants I have given reasons for; but I am not chemist enough to offer a reason for the prevalent glaucous colour, though I may have my conjectures.

I must now leave the subject for yourselves to follow out. I hope any of you who may have the chance will especially look out for these sea-side plants in the course of your Summer rambles. I should like to have said a few words upon various intermediate forms, such as one of the two forms of the common Bladder Campion, both of which may be found between the "Valiant Sailor" and the Lady-Wood, and also upon sea-side ferns. But in mercy to you, as well as to myself, I must stop.

Tea was provided in appropriate style at 4.30 o'clock, and by the time it was over the train had called again for the members.

OPENING OF THE TOWN MUSEUM.

Tuesday, October 4th,

(The following account of the Opening is from the "Folkestone Express.")

As we announced last week the opening of the Town Museum by His Worship the Mayor (T. Caister, Esq.), took place on Tuesday last. Previous to the formal opening, the ladies and gentlemen who crowded the room, amused themselves by inspecting the contents of the different cases, and certainly there was no lack of objects of interest to attract the attention for a long time.

The Mayor ascended the platform a little after eight o'clock, and was accompanied by Dr. FitzGerald, the President of the Folkestone Natural History Society; Alderman Gambrill; Councillors Pope, J. B. Tolputt, J. C. Davidson, T. Harrison and J. Fitness; the Town Clerk (W. G. S. Harrison, Esq.); Rev. C. L. Acland; Rev. C. J. Taylor; C. Dashwood, Esq.; J. Clark, Esq.; and Mr. E. M. Place. The following gentlemen were amongst those present:—Rev. M. Woodward, Vicar of Folkestone; H. B. Mackeson, Esq., of Hythe; and Mr. H. Ullyett, the Secretary of the Folkestone Natural History Society.

The Mayor, who was received with cheers, said—Ladies and gentlemen,—I can assure you that, as the Mayor of this town, it is a source of much gratification to me to have been asked, in conjunction with the members of the Corporation, to open the Museum for this town. It is at all times a pleasure to assist in a noble act, and in such a work as the formation of the present Museum, it is especially so, as it can but conduce so much to the interest and benefit of the town. Everyone looking at the beautiful specimens of Natural History around us, can but be delighted and wonder at the labour which has been bestowed. I trust that the present Museum will form the basis of a large collection, and that this day will in times to come be looked upon with delight and much thankfulness. Another benefit will, I hope, also follow—that it will induce all our neighbours to join us, and that the Mu-

seum, flourishing as a Museum of Natural History, will rally around ns Antiquarians also, whereby the benefit will be much increased and much public advantage gained. I have to tender the grateful thanks of the town to the members of the Natural History Society and the other gentlemen for their great labours, and especially to the President (Dr. Fitzgerald), the Rev. Mr. Acland and the Secretary (Mr. Ullyett), and I trust that their exertions will long be appreciated and enjoyed. It is gratifying also to see the collections of several of our townspeople and friends, and a careful inspection of the collection of Mr. Robinson, which is before us, will be well repaid—much honour is due to all and richly are all deserving of the best thanks of the town. I do thank you all, and with best and hearty wishes for success, I declare this Public Museum for the town of Folkestone to be duly opened.

Dr. FitzGerald said on looking round the room he could do no less than congratulate the whole town on the formal opening of the Museum, and he could do so the more heartily because he knew the heap of dirty rubbish which had been brought into the shape they saw before them; he had nothing to do with the work himself. In the first place he thought the thanks of the town were due to the Mayor and Corporation, who had made a very liberal grant of money to prepare the place for the reception of the articles; the Town Clerk had also made his best exertions in the matter, in fact he had been indefatigable; to Mr. Springall, the Town Surveyor, they also owed a deep debt of thanks, and they were under a very heavy obligation to Mr. Acland, who had used his utmost exertions, and with the able assistance of their excellent Secretary (Mr. Ullyett), had been able so far to complete the work. They had also a great deal of assistance from several other members, amongst whom were several ladies. He might mention that they hoped in time to have room to add an antiquarian branch to the Museum, which was a study that greatly interested many, and would increase the attractions of the place. (Applause).

Mr. W. G. S. Harrison (the Town Clerk) said he had been asked by the Mayor to give the Meeting a little idea of how they became possessed of a Town Museum. In the town, lived some years ago a gentleman of the name of Samuel J. Mackie, who devoted the greater portion of his time to making

a collection of fossils, and other objects of interest; he intended to leave, and having this collection, some public spirited gentlemen came forward to secure it for the town and to preserve the specimens; Mr. J. G. Breach was one of the gentlemen who came forward in this handsome way, and with the assistance of the then chief magistrate of the town (a predecessor of the present Mayor), asked the Corporation to accept the specimens and to supply a room for their reception. Tne Corporation accepted them most willingly through the then Mayor (Mr. Boarer), and passed a resolution thanking Mr. Breach for his handsome presentation. These were the brief facts that led to the establishment of the Town Museum now opened; the Corporation had furnished that room, and they had the satisfaction of knowing that the specimens were now so arranged that they would contribute to the education of the people of the town, and it can but be gratifying to Mr. Breach that his wishes have at last been fulfilled, and that he is the founder of such a valuable Museum for the town of Folkestone. He hoped those who could would join the Folkestone Natural History Society, and aid them in their good work by giving them every support. (Applause).

The Rev. C. L. ACLAND said as his name had been specially mentioned in connection with the work they saw before them, he would say that he was very glad he had the work to do. (Applause). It had been rather hard work certainly; but he was much interested in it, and the willing assistance of Mr. Ullyett was invaluable (applause), and a great deal yet remained to be done. The Museum they saw that evening was not, he might say, the original one, as a great many of the articles exhibited were loans from friends who had kindly come forward to assist them. They had so many fossils to arrange that he could not say much about them. Thus far they had had all hand work in placing the specimens, but now they had a great deal of head work to do in naming them, and to do such work effectually almost demanded the presence of the original collector, as the want of the date and locality where the specimens were found left them rather in the dark as to the character of the fossils. In his opinion a Museum should be a complete repository of all local natural objects—it ought to show specimens of all that the neighbourhood could contribute; he need hardly remind them that the neighbourhood

was very rich in the objects required. A portion of the Museum should also be devoted to the exhibition of all objects; that would be, of course, a work of time, and could only be effected by exchanges, and they had not much to exchange, having only one thin bed in which any rarities were found; he alluded to what was called the Folkestone Junction bed, this had nothing whatever to do with the Junction station (laughter), but was a bed lying between the Lower Greensand and Gault; they could work that to advantage. All Town Museums ought to have a speciality, the one at Salisbury had made a speciality of exhibiting flintheads and other vestiges of pre-historic life; he believed the speciality of Folkestone should be an exhibition of foreign and colonial produce—solids and liquids, and he was glad to find that a collection of these objects had been lent by Mr. Robinson, a collection that had gained a prize medal at the South Kensington Museum. He would now say a few words as to the addition of an antiquarian section; he believed that a lot of antiquarian objects existed in the neighbourhood, and the fine field of employment the investigation would open out, was sufficient to encourage the adoption of the suggestion. By doing this they would get hold of many people who were fond of rummaging (laughter); all men liked rummaging in something or the other, some in natural history and others in antiquities. They also wanted a library of reference; a great many people had reference books lying useless on their shelves and would be glad to send them if they knew that they would be preserved in a fitting place, easily accessible to those who study; those of course who could not give books would not be too proud to contribute the money for the purchase of some (laughter). They must not forget that had it not been for the extreme liberality of the Corporation they would never have had the room they were then in so well fitted up. A word about classes and lectures; he had the pleasure of conducting a class on elementary botany last winter, and he was glad to know that many novices who attended had become to a greater or less extent botanists; they could, no doubt, form classes with similar results in the other branches of science if they could only find the scholars, and if they found the scholars he would undertake to say the Society would do their best to find the teachers. (Loud applause).

Several persons here asked for Mr. Ullyett, but that gentleman not being in the room

The Rev. C. J. Taylor said he was asked to remark how much they were indebted to Mr. Ullyett for the careful arrangement of the specimens, nearly half those exhibited that evening being Mr. Ullyett's own property, and the feeling of thankfulness and obligation was loudly responded to and with applause.

Dr. FitzGerald proposed a vote of thanks to the Mayor for presiding, which was seconded by the Rev. C. L. Acland. The Mayor responded, and the formality of the Meeting terminated, the remaining time being devoted to the inspection of the several valuable objects and specimens in the cases.

Wednesday, November 23rd,

Evening Meeting at the Museum. There was a large attendance. Several microscopes were on the table, and a large collection of objects, living and mounted. The following paper was read by the Rev. C. L. Acland, for Mrs. Bateman :

ON THE YEAST PLANT.

If you use your Microscope as a mere plaything wherewith to amuse an idle hour, passing specimen after specimen beneath its revealing power, without a care to enquire into the structure, habits, or functions of the marvellous object which you admire, you will soon tire of it, and put it away as an uncared for toy. If, on the contrary, you use it as a means of diving beneath the surface of things, of making you come face to face with Nature in all her protean shapes—ever changing, yet ever the same, of endless variety, yet ever one—it will possess for you an increasing fascination, and you will use it again and again, with renewed interest, to peer into it for some mighty secret it can alone reveal; or to fix beneath your scrutiny, some field where the minutest forms of organic life perform beneath your eye their functions, subject to laws as invariable and peremptory as those which govern the highest life.

It is with the Microscope, rightly handled, that proofs have

been obtained that the line between animal and plant existence can hardly be drawn. The greatest of our Microscopists, men with names of world-wide celebrity, have not able to determine where plant life ceases and animal life commences; whether plants swimming freely in the water were not animals, and whether animals firmly rooted on stones or vegetable matter were not plants.

Plants are found to be closely allied to animals in structure, organisation, and vital power. They are living bodies; they are the offspring of beings similar to themselves; they grow, are endowed with excitability, or the power of being acted on by external stimuli, such as light, heat, &c., impelling them to the exertion of their vegetable power; they have their periods of infancy, adult age, decay and death. The truth of this you can test with your own Microscope, by procuring some specimens of the lower forms of plant life and placing them under the low power.

As the present weather is not inviting for a walk to the Warren, or some favourite pond or ditch, armed with net or spoon wherewith to skim the surface of the water for the various scums, which, we so well know, are composed of the myriad forms of beautiful Diatoms and Desmids; if we can bring home no newt or small frog, in whose fin-like tail and webbed foot, we can view the process of the circulation of the blood (beautifully displayed); we can find nearer home, forms of life quite as interesting, giving us as deep an insight into the mighty secrets of the laboratory of Nature. It is well said that "the vegetation which everywhere adorns the surface of the globe, from the moss that covers the weather-worn stone to the cedar that crowns the mountain top, is replete with matter for reflection. That not a flower or leaf that expands beneath the sunlight, but has something of habit, of structure, or of form to arrest the attention."

Though the origin of one-celled plants, of the laws which cause, as well as govern their reproduction, belongs to the higher walks of science, and is beyond the reach of the humble every-day Microscopist, like myself, the power of watching their various forms and functions, of being present at some interesting process, as it takes place beneath the eye, is not denied to the youngest tyro amongst us. This we can easily put to the proof, and since, as has been said, it is out

of the question to go and look for some diatoms to inspect, we must go and ask the nearest brewer for a little yeast. The hot and busy workman grants our petition, wondering the while at the satisfaction with which we receive what is not enough to leaven a baking for the smallest of fairies, or influence, at least for some time, the wort in which it is floating. Delighted with our prize we hasten home, place a minute portion of it in the animalcule cage, with a small drop of warm wort for it to float in, and we slip it in with eager interest beneath the low power of the Microscope. Here we have at once the first and most curious exemplification of a simple cell. This well-known fungi is called the Yeast Plant, and consists of two parts, the cell wall, composed of a matter called cellulose, and the contents of the cell resembling fat or oil. The notion that Yeast was an organised being, in fact, a living plant, was at first strongly opposed by some of the first men of science. The Microscope, however, has convinsed them both of its organisation and vitality! It consists of globular or egg like transparent cells with a nucleus or spot. To watch its changes with efficiency it must always be mixed with a small quantity of newly-made beer. One hour after it has been added to the wort germination commences, and two buds, or cells, are produced on either side of the parent cell. Eight hours after the plants begin to ramify, or throw out slender fibres, some exploding and emitting a fine powder. In three days pointed filaments with lateral branches are produced. Such are the changes to be seen by the patient Microscopist, who will thus have had an insight into the manner in which the germination and reproduction of the first life form is conducted. There are other forms of Yeast Plant existing under different circumstances, even in the human body; but as these few remarks are only to call attention to the wonders every-day life may furnish to our Microscopes, they are beyond our reach, indeed, strictly confined to the search of professional or highly scientific men. It may content us to know that the governing laws which influence them, are the same as those governing the common Yeast Plant of beer.

Of the same sort of one-celled plants is the fungi, or mildew blighting grapes. "Grapes," says Mr. Harris, "when blighted, are covered with what appears to be a white powder like lime, a little darkened with brown or yellow. These dark spots are

the fungi which send forth laterally, in all directions, thread-like filaments which become so entirely interwoven, as entirely to cover and enclose the skin of the grape in a compact and fine network, and on each is seen the egg-shaped capsule or seed pod. Mildew in corn—the potato, tomata, cucumber diseases—are all fungi of the same description.

Moist rocks, stones, and old walls will also yield specimens within our reach of interest, quite as great as the Yeast Plant, or any of these minute fungi. There is a plant called the Gory Dew, which appears as a red stain on the surface of damp objects. If a little of this is scraped off the part to which it is attached, it will be found, under the Microscope, to consist of a number of separate minute cells. This plant belongs to the same family as the red snow plant; the rapid growth of whose minute organism has given rise to alarm and fear when its true nature was not understood. One of this family attacks bread, and gives it the appearance of being dipped in blood. Ale mould, subjected to the Microscope, will amply repay, by its simple structure and rapid growth, the patience of the investigator. The mould found on the surface of preserves, consists of a mass of filaments or threads serving as its base, from the which filaments arise bearing a number of minute cells, which are spores or reproducing organs. Plants of this kind are to be found on leaves in Autumn, forming irregular spots of a yellow, red, or black colour. If wheat is allowed to germinate in a damp place, the little rootlet it sends down will be found covered over with minute fungi. Seeds as well as fruit are liable to the attack of fungi during their decay; it attacks even the oil casks in the London Docks, its fibres resembling threads of black silk, whilst the spôres are scattered about the fibres. As before said, fungi attack the human body, and are found to be the cause of several painful and fatal diseases. It is *probable* that in all fungi, and *certain* that in most of them, the first development of the plant consists in filamentous or thread-like matter which radiates from the centre formed by the spores or seeds, and the cellular spheroidal appearances are subsequently developed with a view to the dispersion of the spores. So much for the minute fungi which may be enjoyed by young Microscopists at all seasons of the year.

In Summer a drop of water from the Warren or Walton

ditches will furnish them with many beautiful forms of a higher vegetable life, opening up a new field of wonder and delight; leading them on, by a species of fascination, to seek more and more to look into their structures, growth, and habits; to marvel with mute admiration at the wisdom of the Creator, Who has lavished such infinite variety of form, colour, and beauty on the myriad individuals of the invisible things of His kingdom, though the question may arise in our minds, whether the portion of His Divine intellect, which He has been pleased to bestow on man, is not to be marvelled at still more, enabling man, as it does, to construct an instrument like the Microscope, without which the wonders of that kingdom would have remained for ever invisible to us.

The following paper on LOCAL BOTANY was written last year by Mrs. FitzGerald:

It was the 19th of February. I was very tired of the cold weather and lack of flowers, moreover, I thought I knew a sunny spot, at the foot of the hills beyond Cæsar's Camp, where I might, perchance, find some early violets. It *was* cold, snow lying in the ridges of the ploughed fields; but the sun shone, *that* was something, so I walked on bravely, daring the cold and the hill, and as a reward for my courage, found my violet bank, near Cæsar's Camp, so sweetly full of flowers. It was sheltered from the winds—no snow there. I flew at my flowers and soon had a bunch of great variety, for on this same bank, dark blue, pure white, the dingy dark red, and the lovely light mauve flourish altogether. I came to one especially fine bunch and prepared to gather them, but was startled very considerably, at seeing a large adder coiled up asleep on a branch of Sloe bush, which hung just above the coveted treasures, a most luxurious reptile to choose such a spot to repose in; the noise I made startled it away, but I could not venture on those particular flowers. I followed a little brooklet on my return and found the little *Adoxa moschattellina* in another sheltered corner, and two or three Primroses, and very delighted I was with my morning's ramble. It was some days later than this, that in another walk I found Snowdrops *(Galanthus nivalis)*. I had surmounted the same hill, fol-

lowing a path in the side of it, which at the top, by crossing a field takes one into a network of lanes—it was in one of these lanes I came on a bank adorned with these flowers. I believe they are very rarely found here, these are the only ones I have ever seen. I may mention that this same lane abounds with a variety of wild flowers, the Wood Sorrel *(Oxalis acetosella)*, the White Dead Nettle *(Lamium album)*, the Yellow Weasel Snout *(Galeobdolon luteum)*, Primroses, Violets, Blue Bells, Lychnis, Bugle, and some lovely ferns.

A walk through the Alkham valleys will well repay the Botanist; it is one of our richest localities. Leading from the main road, on the left hand side, is a wood full of Lent Lilies *(Pseudo Narcissus)*. This year I found them open as early as the 25th of February, but I warn whoever goes in search of them to be provided with strong boots, and clothes warranted not to tear, for they are guarded by the most formidable of thistles, and the most vicious of brambles; many a shriek has proceeded from the luckless young friends I have sometimes taken with me in my excursions, and I really cannot describe the various accidents which have befallen them.

To return to the hills above Folkestone. They abound with early and late Spider Orchis *(Ophrys aranifera* and *O. arachnites)*, the Bee Orchis *(O. apifera)*, the Ladies' Tresses *(Neottia spiralis)*, Dwarf Orchis, &c., &c.; so also the Little Milkwort *(Polygala vulgaris)* in endless variety of colour, the Yellow Rock Rose *(Helianthemum vulgare)*, the Perfoliate Yellow Wort, and varieties of the Bellflower; in fact, so great a variety is there to be found, that on one occasion I counted 40 kinds of flowers open at one time in a distance of about 100 yards. I must mention that on the Canterbury road, not far from the Chalk Pit, I have found the sweet Milk Vetch *(Astralagus glycyphyllos)*. The only other places near here that I have found it in, are near Aldington and above Brabourne on the road to Wye. We come now to May, that delicious month to the lovers of Nature, and especially rich for the Botanist. I hear in a wood near Etching Hill that the Solomon's Seal *(Convallaria multiflora)* is to be found. I determine to find it. It is a very dense wood on the side of a hill, and necessitates crawling along, on hands and knees, uphill; but away we go. How lovely is the moss, now full of Primroses—now full of Bluebells. What is that crawling

along too, in much the same style as ourselves? A large *adder;* this time I am equal to the emergency and soon kill it, and am not sorry to be able to stand upright and enjoy the sight of a large mass of the flowers I am searching for. How lovely and delicate they are, and how gracefully they hang! "Just like pounds of candles" a non-poetical friend of mine once observed to me. Provided with specimens we grope our way through the bushes 'till we come to something like a path, and following that, more treasures await us—the Toothwort *(Lathræa squamaria)* in great quantities, nearly over, but some stray flowers were still worth gathering; Herb Paris too, the five-leaved variety occurring frequently; Wood Anemones, some a dark red; and lastly the Sweet Woodruff *(Asperula odorata)*.

Quite tired we prepare to go homewards, and on our way come across several roots of the Orphine or Livelong *(Sedum telephium);* it does not flower till August (and that by the way also grows in great quantities in the old Priory woods, Aldington). We emerge out of one wood and ascend the hill by the road; about half-way up, on the right hand side, is a bank full of the Green Hellebore *(Helleborus viridis)*. Here too is the Wild Currant *(Ribes rubrum)*. We decide to return when the fruit is ripe. Our day's excursion is over and we return laden with treasures.

Next on my list of Spring flowers is the lovely Lily of the Valley *(Convallaria majalis)*. Westwood is the habitation of these flowers, where they grow in profusion among beds of *Blechnum boreale* and the handsome Wood Lastræa. Many a pleasant excursion have I made to these delightful woods, and often have I heard their depths resound with the merry laughter of little hunting parties from Folkestone, Hythe, or Canterbury. There are also many other flowers here, among which I may specially mention the Foxglove *(Digitalis purpurea)*. These are grand flowers and have a specially magnificent appearance there from the abundance in which they grow, quite introducing their colour into the landscape. The common Heath *(Erica cinerea)*, and the Ling *(Calluna vulgaris)* is also found there—I think the only place in which I remember to have seen the former in this neighbourhood, except one small patch of it in the road that runs across the hills from the top of the Dover hills to the Canterbury turnpike.

In East Wear Bay I have found the Rose Bay Willow Herb *(Epilobium angustifolium)*, it is rather an uncommon plant, but in Challock Woods, near Wye, grows in profusion. In Sandling Park I have found the Bird's Nest Lystera. I may mention that in the dykes near Mersham, the Yellow Water Lily *(Nuphar lutea)*, and the Flowering Rush *(Butomus umbellatus)*, and large Water Forget-Me-Not *(Myosotis palustris)*, are found in abundance; also the Great Yellow Loose Strife *(Lysimachia vulgaris)*, which is, I believe, rather rare. In fact along these dykes are endless treasures, and if the lover of wild flowers takes the train to Smeeth, and devotes a few hours to a ramble along them, he will be well repaid.

Near Hythe, in one of the dykes parallel with the canal, I found the little Frog-bit *(Hydrocharis Morsus-ranæ)*, it is very lovely, as I daresay you all know. I was sorely tempted to get some for my aquarium, but of course the finest specimens were all farthest from the bank. At last, with great difficulty, I got down to a firm footing, and armed with an umbrella with a crook, prepared to make a grab; but imagine my horror when I saw lying, well stretched out on my lovely flowers, a black water snake nearly a yard long. They are quite harmless, these dyke snakes, but my philosophy did not represent that fact to me at the time. Up I rushed with a scream, and my black friend, in a dignified manner (quite an example to me), glided quietly away into the dark waters.

You will be tired of me and my snake adventures, so I will detain you no longer, except to say, that this Spring, when feeling I had searched the neighbourhood, and had, I feared, no more botanical novelties to find, at Beechborough I discovered the Adder's Tongue *(Ophioglossum vulgatum)*, growing plentifully both in the woods and meadows.

Loans and Donations towards the Library.

The following books have been presented by the Rev. C. L. Acland:

Gosse's Year at the Shore.
Babington's Manual of British Plants.
Rye's British Beetles.
Page's Advanced Text-Book of Geology.
Catalogue of the Colchester Museum.
Tabular View of British Fossils.
Local Museums.

By Dr. FitzGerald:

A Donation of Five Pounds, and
Aldeborough, its Natural History and Antiquities.

By R. W. Boarer, Esq.:

Huxley's Physiology.

The following have been lent by C. H. Dashwood, Esq.:

British Fungi.
,, Mollusks.
,, Reptiles.
Sowerby's Conchology.

By F. Tolputt, Esq.:

Old Red Sandstone, by Hugh Miller.
Testimony of the Rocks ,,
Recent and Fossil Shells (Woodward.)
Richardson's Geology and Palæontology.
Mantell's Geology of the South-East of England.
Lyell's Principles of Geology.
Tabular View of British Fossils.
Cahier's D'Histoire Naturelle, 2 vols.
Lyell's Elements (1838).

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FOURTH

ANNUAL REPORT

OF THE

FOLKESTONE

NATURAL HISTORY SOCIETY,

WITH

STATEMENT OF ACCOUNTS,

AND

FULL LIST OF THE SOCIETY,

FOR THE

YEAR ENDING DECEMBER 31ST, 1871.

TO WHICH IS ADDED

A LIST OF BIRDS

OBSERVED IN FOLKESTONE AND ITS NEIGHBOURHOOD.

PRICE THREEPENCE.

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Penfold, S., Esq.
Penfold, Miss
Penny, Miss
Place, E. M., Esq.
Place, Mrs.
Poole, H. W., Esq.
Poole, E. J., Esq.
Pope, Mr. W.
Pope, Mr. H.
Porter, Mr.
Ramell, Mr., Jun.
Ratcliffe, T., Esq.
Ratcliffe, Miss
Robinson, Mr. J. D.
Scholey, G. M., Esq.
Shillingford, Miss
Smith, Mr. R.
Springall, Mr.
Stace, Miss
Stallwood, S., Esq.
Stewart Colonel
Stock, Mr.
Stringer, Miss
Sturges, Mr.
Sweeney, Captain
Taylor, Rev. C. J.
Taylor, A. C., Esq.
Taylor, A. H., Esq.
Thompson, Miss
Tickell, Mr.
Tolputt, F., Esq.
Tolputt, W. B., Esq.
Tolputt, W. B., Esq., Jun.
Tolputt, Mr. J.
Torkington, Mrs.
Torkington, Miss
Touche, Mrs.
Tristram, Miss
Turner, Mr.
Tyson, Miss
Ullyett, Mr.
Underwood, T., Esq.
Ward, Miss
Warburton, Miss L.
Wellard, Mr., Rendezvous Street
Weston, Mr., Sandgate Road
Weston, Mr., Guildhall Street
Whittingham, Mr.
Woodward, Rev. M.
Yunge, Mrs.

FOURTH ANNUAL REPORT

OF THE

FOLKESTONE

NATURAL HISTORY SOCIETY.

THE close of the Year 1871 brings us nearly to the termination of the fourth year of the Society's existence. The Committee have great pleasure in being again able to note an increase in the number of members, which has now reached 170, and they cannot help looking upon this as a proof of the increasing interest felt in the Society. Since the last Annual Meeting there have been held nine evening meetings and two field days; the limited number of the latter being in consequence of the uncertainty of the weather on several occasions. A list of the papers will be found in the "Proceedings." On the whole the meetings have been well attended, but on two occasions the Committee regret to state the numbers scarcely justified the trouble taken by those who had written the papers. By particular desire the one on "Protoplasm" will again be read to night.

The Museum continues to attract numbers of visitors, and has had several donations during the past year. Among these may be mentioned

Ores and Fossils from Canada, obtained by W. Tyson, Esq.
Gold and Silver Ores, by W. J. Jeaffreson, Esq.
Marine Shells, by Mrs. Peck.
Case of Foreign Insects, by J. F. Macqueen, Esq., Q.C., per W. G. S. Harrison, Esq.
Euplectella speciosa, Snake's skin, &c., by Capt. Owen.
Gigantic Lobster, by Mr. Baker, High street.

The Balance Sheet is rather more favourable than last year,

as the extra expenses incurred have not been so heavy. The following papers have been printed, and are at the service of the members :—

"The Great Bustard," by Mr. Ullyett.

"The Dandelion," by the Rev. C. L. Acland.

"Ten Minutes in the Moon," by Dr. Fitz Gerald.

The Committee regret that the funds have not allowed of the others since read being printed, and which really ought to be in the hands of the members, but they feel that while the present large stock of publications remains on their hands, they are not justified in incurring fresh expense in that direction.

DR. BALANCE SHEET. CR.

RECEIPTS.	£	s.	d.	EXPENSES.	£	s.	d.
To Subscriptions for Exploring Fund	2	4	0	Due to Treasurer last year ..	1	5	10
,, Receipts by Lectures 1870-71	2	2	6	By Printing	15	12	6
,, ,, Classes ..	2	15	5	,, Stationery	0	15	7
,, ,, Publications	1	14	11½	,, Postage and Delivery ..	1	8	6½
,, ,, Fares to Lyminge	0	18	0	,, Museum Expenses	11	3	10
,, Received from the Corporation	10	0	0	,, Sundries	2	10	10
,, Receipts by Subscriptions	21	17	6	,, In hanl	8	15	4
	£41	12	5½		£41	12	5½

Hy. ULLYETT,
HON. TREASURER.

PROCEEDINGS OF THE SOCIETY.

THE Third Annual Meeting of the Society was held on the evening of February, 7th, 1871, at the Museum, High Street. The weather was exceedingly unfavourable, and in consequence the attendance was smaller than usual. The Secretary read the Report of the Committee and the Balance Sheet for the year 1870, which, owing to extra expenses incurred in connection with the Museum, showed a deficit for the first time.

The President then read his

ANNUAL ADDRESS.

Ladies and Gentlemen—

It is, indeed, a source of unfeigned satisfaction to me to look round this room and reflect on the progress we have made since I addressed you this time last year. Our Society has continued to prosper, and to advance in a very material manner; not only have our numbers increased, but we have gained an immense advantage in the acquisition of this room, and the Museum it contains. For this we have to thank the indefatigable exertions of Mr. Acland and Mr. Ullyett, and the liberality of the Corporation. It is impossible for any one who did not see the state of dirt, confusion, and decay in which the specimens were, to form any idea of the labour entailed in their present arrangement, nor must you imagine that this arrangement is complete, for there still remains much, very much work to do, and I hope that many of you will follow the excellent example set you by one or two of our lady members, and volunteer your services for the cleaning and arranging of the remaining specimens. Mr. Mackie has kindly offered his services for the same purpose, and I trust by this time next year the Folkestone Natural History Society and the Town of Folkestone may possess a Museum worthy of their increasing importance. I wish there were no *per contra* side to this account of our progress; but I need not remind you that we have lost in Mr. Acland one of the mainstays of our Society. Often and often shall we miss his kindly face and his clever and original papers, lectures,

and addresses, which while replete with the deepest truths of science, were still brought within the comprehension of the merest tyro. Nor have all our members shown that zeal in the prosecution of science which we might fairly have expected, for the prizes offered for the best collections in Botany, Geology, and Zoology, have not been even competed for. All this will, I hope, be gradually altered, for in the pursuit of studies such as ours I can hardly conceive that any one who has ever put his hand to the plough can ever draw back. What can possibly be more ennobling than the humble pursuit of Natural History studies? Does it not engender truth, candour, patience, humility, patience, sagacity, and last but not least, *freedom from prejudice and partizanship?* It is a contest in which all must win.

"Who strives, he wins, and gathers might,
For other future sterner fight."

I was in hopes I might have told you something to night of the result of the Eclipse Expedition, the preparations for, and objects of which were so graphically described in Mr. Acland's admirable lecture; no authentic account has, however, yet been published, and one can only glean a few particulars from the newspaper reports. You remember, one of the chief objects of the expedition was to determine the true nature of the corona,—the white bright halo seen beyond the dark body of the eclipsing moon; whether it was an effect produced by our atmosphere, whether it was a solar atmosphere, or whether it belonged to the moon. The weather was so cloudy, however, in Africa, Spain, and Sicily, that all the elaborate preparations and expensive and delicate instruments were well nigh proving useless, In one or two of the more fortunate stations they were able satisfactorily to determine that the corona was radially polarised, and was, therefore, really a solar appendage. The strangest point is its spectrum, which gives bright green lines, indicating the presence of some new and totally unknown substance. What is this unknown element? Shall we ever know? We know it is neither hydrogen, iron, calcium, sodium, or any element we know. Can it possibly be that we have obtained a first glimpse of the cosmical ether, which fills all space, and in which all planets, suns, and stars float. The only spectrum

we know which is at all like it, is that of the Aurora Borealis, and there we are equally ignorant of the element which produces the green line.

And now to turn to another subject, and one well worthy of your consideration. One of the principal objects to which our members should give their attention is the search for flint implements, arrow heads, hatchets, and fine flakes; nor, indeed, is any fragment of flint which bears even a suspicion of having altered in its shape, however rudely, without interest, for it is by means of these flint implements that we have been able to ascertain as much as we now know of the life, habits, and even moral character of pre-historic man. Till within a comparatively recent period we were quite content to accept the doctrine that the whole age of created man dated back only some 6,000 years. Before that period we knew there existed various antediluvian monsters—mammoth, mastodon, megatherium, &c.; but no one for a moment believed that man was co-existent with them. It is true that some facts, such as the great diversity of races at the earliest historic date, some 2,000 or 3,000 years B.C., the information to be gathered from diluvial deposits, &c., &c. militated against this theory, still "So much the worse for the facts!" But of late years such decisive discoveries have been made that they have convinced the most sceptical that the age of the world, and even of man, must be counted backwards, not by thousands, but by hundreds of thousands of years. Flint implements, arrow heads, hatchets, &c., of undoubted human manufacture, have been discovered in immediate proximity to the bones of long extinct mammalia; nay, these very bones are found notched with the edge of the primitive flint knife, cleft for the purpose of extracting the marrow, so dear to the palate of primitive man (a taste which is not yet quite extinct among his descendants), and the rude arrow heads of our forefathers have been found embedded in the skulls of the great extinct cave bear, &c. Thus Baron Bunsen is forced to admit an antiqnity of the human race of 20,000 years, and Sir Charles Lyell is disposed to regard the glacial period, when, as we know, the whole of Northern Europe was shrouded in ice, as representing a period of 800,000 years ago, and from certain data, based on the slow formation of chalk, Sir John Lubbock has calcu-

lated that the denudation of the Wealden Valley must have required more than 150,000,000 *of years*. These figures seem to us enormous, but to the Geologist, who traces the vast changes which our globe has undergone, and who knows how slowly some of them must be and are still effected, there is nothing extraordinary in their magnitnde. However, as Lubbock remarks—" Our belief in the antiquity of man rests not on isolated calculation, but on the changes which have taken place since his appearance: changes in the geography, in the fauna, and in the climate of Europe; valleys have deepened, widened, and partially filled up again ; caves through which subterranean rivers flowed are now left dry, &c." Thus the vast desert of Sahara was undoubtedly once sea; its cliffs and ancient beaches are still quite visible, and the common cockle is still found living in some of its salt lakes, and there can be no doubt that what are called Europe and Africa were at this time united. But the question now arises, What manner of men were these our early ancestors? Were they a fairer, stronger, wiser race than ourselves, or do we derive our origin from a type far lower than our own, or even, as some would have us believe, by insensible transitions and development from the ape? What was Primitive Man like? This is a subject on which there has been much controversy, but I think all the weight of evidence tends to prove most clearly that pre-historic man was very like, both in physical structure and mental development, what the best advanced of modern savages are now. Thus if we take the few fossil skeletons which have been found under circumstances free from all suspicion as to age, we find a skull which is not unlike that of many existing races of the present day, while the bones of the leg are thicker and the insertions of the muscles are more prominent, as might be expected in men who led so active and savage a life. Thus of the Engis skull, about whose antiquity there can be no doubt, Huxley says " It is a fair average human skull, which might have belonged to a philosopher or might have contained the thoughtless brains of a savage." In the case of one other most remarkable skull—the Neanderthal skull, it is, however, very different, the sloping forehead and enormously thick and prominent superciliary ridges certainly give it a very apelike

appearance; but setting aside the fact that its age is not so well authenticated, we have no evidence to prove it was not an exceptional skull and might very likely have belonged to an idiot, at any rate none other has been discovered at all like it, nor have any transitional forms ever been brought to light, as we might have reasonably expected. We may then, I think, take it as proved that primitive man was what we shall now term a savage of a very low type, and whom we can well picture to ourselves by comparison with many of the existing savage races. There is no evidence of any race ever losing its natural mechanical contrivances, such as the use of flint and steel, spinning, &c., and although nations may have degenerated from over civilisation, it is not likely that any race of men would ever forget what contributed to their material comfort and support. From this argument it follows, says Sir John Lubbock, "The lowest races of existing savages must, always assuming the common origin of man, be *at least* as far advanced as were our ancestors when they spread over the earth's surface." The history of Primitive Man has been conveniently divided into two great periods. The Stone Age and the Metal Age. These have been again subdivided into I. The Rough Stone Age, or that of the Drift, when the mammoth, great cave bear, hairy rhinoceros, and other extinct animals existed, when, of course, no metal was in use and the stone implements were unpolished. II. The Polished Stone Age, or Reindeer Epoch, when the stone implements were polished, and vast herds of reindeer roamed the land; and towards the latter end of which domesticated existing animals begin to appear. The Metal Age, may be divided into—I. The Bronze Age and II. The Iron Age. In the first of these bronze (an amalgam of tin and copper) was in sole use while stone implements were still in existence; in the second iron superseded bronze for tools, &c., while the latter was used for ornaments, &c. During the first part of the Stone Age man's life must have been indeed hard and savage, his food could have consisted only of roots and fruit; in constant danger from the attacks of enormous and savage animals, among which the huge cave lion and the vast and savage cave bear were prominent; without weapons to defend himself, and forming but a very small minority of existing

animals, he could have trusted only to swiftness and cunning for his safety; no covering but the skins of the smaller animals he was enabled to catch and devour raw. Such must have been the first appearance of man on the earth; soon, however, would his superior intelligence begin to assert itself. His first attempt at self defence would be some knotted club. He would then see, strewing the ground, the sharp flints which now served only to wound his naked feet. The first step to all arts, manufactures, and civilisation was made when the first man struck the first blow in a crude attempt to fashion some rough weapon from a flint! A jagged flint wedged in a cleft stick would soon supersede the club and enable him to attack animals more powerful than himself; his next step in advance was kindling a fire, though at what period he first learnt to do, or by what means he succeeded, we can never know, probably in the same way as some savage tribes in the present day, by rubbing together two dry sticks. As this way is tedious and uncertain, he must have endeavoured, as do modern savages, to keep the flame burning by supplies of resinons wood, &c., though it would probably uot occur to him to adopt the ingenious device of the Faroe islanders, which is to draw a wick through the body of the Stormy Petrel (a bird containing a large per centage of fat) and light the end which is left projecting at the beak! Primitive Man must soon have attained great perfection in the only mechanism he practised, namely fashioning tools and weapons of stone, for flint knives, hatchets, spearheads, and arrow heads are found in enormous numbers wherever pre-historic remains are met with. Pottery was, probably, the next art learnt, for fragments of vessels, rough and rude, with the marks of the primeval maker's fingers still on them, were discovered in the cave of Nabuges, by the side of a skull pierced with a flint arrow head, and other remains. Caves were evidently used as shelter by these our remote ancestors, probably after they had been evacuated by their first tenants, which were hyænas, bears, &c.; and they were also used as burial places, one of which was recently discovered in France containing no less than 17 bodies, which the over-zealous Mayor of Aurignac unfortunately ordered to be buried in the parish churchyard, and they were thus for ever lost to science! Were the men of the Stone Age cannibals?

Well, I am afraid the evidence directly tendst hat way, nor need we be surprised if they were, as many savage tribes practise it even in our own day, at any rate children's bones have been found split open for the extraction of the marrow, and still showing plainly evidence of cooking and the marks of human teeth. That their dress was pretty much like that of modern savages, and consisted of skins, we may conclude from the fact of their bone needles and bodkins, flint piercers, &c. being almost identical with those in use with the Esquimaux and Laplander of the present day; their ornaments too were much the same, and consisted of teeth or shells perforated and strung together. In one of the Bone Caves lately discovered in France there were found, among other things, no less than 22 pounds weight of the bones of the water rat, either scorched or roasted, and which had evidently served as food when more inviting fare had failed, so there was at any rate no novelty in the poor Parisians eating rats during the late disastrous siege. The most interesting relics of the polished Stone Epoch are furnished by the "Kjoekken-moeddings," or "Kitchen-middens," which means simply kitchen refuse heaps, these are large flattened mounds or beds of shells; they were long supposed to be natural deposits of fossil shells, and their true character has only recently been known,—they mark the site of the villages or settlements of our early fathers, and are of course always situated close to the sea; the huts of our ancestors must have surrounded these kitchen-middens, and each household must have contributed its share of oyster shells, cockle shells, fish and animal bones, &c., forming the heap, which often rises to a height of eight or ten feet, while the length is sometimes as much as 1,000 feet, with a width of 150 to 250 feet. These refuse heaps (first noticed in Denmark) have been found in England, France, Australia, and America. In these kitchen-middens numerous most interesting flint relics have been found and also bones of the domestic dog, who, however, appears to have been frequently eaten by his master in times of scarcity. I have said that pre-historic man buried his dead in caves, but there is now no doubt that during the latter part of the Stone Epoch and the beginning of the Bronze, there arose those mysterious stone structures which have puzzled the world for so many

generations, and which are called Celtic and Druidical monuments, though both Figuier and Lubbock are agreed that they arose long antecedent to the incursion of the Celts in Europe, and must have been as great a puzzle to them as they are to us. There exists not the slightest doubt but that they are sepulchral, and that the majority were originally covered with earth and constituted mounds or tumuli, from which the earth has gradually become detached; some, however, as for instance Stonehenge, were probably never covered. These Dolmens, as they are called, exist in large numbers in Brittany as well as in England, the Channel Isles and various other parts, and even in India we find their exact counterpart. Their essential construction appears to be two or three upright stones with others laid along the top. Numerous skeletons with flint implements and even fragments of dress and bronze arms have been discovered in these Dolmens. Perhaps no discovery has given us so clear an insight into the life and customs of the Stone and Bronze Ages, as the discovery of Swiss Lake Dwellings; this discovery was quite accidental, and resulted from an exceedingly dry season, which so lowered the water in the lakes that numerous piles, ancient canoes, pottery, &c. became visible. Explorations were made which demonstrated the fact that in remote ages dwellings had been erected on piles driven into the bottom of the lake, planks had then been laid over them and the wooden huts constructed on the flooring thus made. The object of their construction was, probably, safety from attack; the labour of driving the piles without adequate machinery must have been immense. Herodotus mentions a lake building, of a similar character, which existed over the lake Prasias in Thrace. He says their habitations are built in the following way: "On long piles sunk into the bottom of the lake planks are placed forming a floor, a narrow bridge gives access to them. These piles used to be fixed by the inhabitants at their joint expense, but afterwards it was settled that each man should bring three for every woman he married. On these planks each has his hut, with a trap door down to the lake, and lest any of the children should fall through, they took care to attach a string to their legs. In this lake fish was so abundant that if a basket was let down from the trapdoor it might be drawn up

shortly after filled with fish." Though this description was written of a people who existed in historic times, thousands of years after the epoch of which I am speaking, it probably very nearly describes the style of lake dwelling inhabited by Primitive Man. I have been able in this brief paper to give you only the boldest, barest sketch of what we have lately learnt of the habits and life of Primitive Man; but I hope I have said enough to show you it is a subject of enthralling interest to the naturalist, and one which any of you may help to elucidate, by the discovery of flint implements or fossil bones, of which many have been found in this neighbourhood.

A short discussion .ook place, after which the Meeting proceeded to elect officers for the ensuing year. All the old ones were unanimously re-elected, the name of Mr. Blackall being added to the Committee list.

Mr. Ullyett then read a short paper entitled "Work Done and Work to Do," urging strongly the formation of sections for working out the productions of the neighbourhood. Several members gave in their names for this object; and sections were formed for collecting Seaweeds, Shells, Birds' Eggs, and Plants.

February 21st.—Evening Meeting at the Museum. The attendance was good. A very interesting paper "On Ants and their Habits" was supplied by Mrs. Bateman, which was listened to with great attention and warmly applauded. The Annual Report for 1870 was on the table.

March 14th.—Evening Meeting. The President read a paper on "Ancient Burial Places," illustrated by drawings. He also placed on the table some Roman remains from an excavation at Saltwood made a short time ago, with a sketch of the position in which they were found. They consisted of a cinerary urn, a vase, and fragments of bones, and had been sent on loan by H. Rigden, Esq.

April 25th.—Evening Meeting. On the table were preserved specimens of the Little Auk, Black Throated Diver, both taken at the entrance to Folkestone Harbour, and the Great Bustard, taken in Northumberland, all lent by V. Knight, Esq. A paper on "The Extinction of Species, and Notes on the Great Bustard," was read by the Secretary, and followed by an animated discussion.

May 13th.—Field Day. The members assembled at No. II. Tower and proceeded to the Warren, where a paper on "The Dandelion," forwarded by the Rev. C. L. Acland, was read. The attendance was smaller than usual, owing to the coldness of the weather, an unpleasant east wind blowing at the time. *Ophrys aranifera* was growing plentifully.

May 23rd.—Evening Meeting. The President was unable to be present, but sent a paper, entitled "Ten Minutes in the Moon," which was listened to with great interest, and caused some little discussion. Mrs. Bateman also contributed a paper on "The Mole and its habits."

August 8th.—Evening Meeting. Dr. Knaggs, of London, read a very interesting paper on "Protective Adaptation among the Lepidoptera," which was followed by additional remarks from Major Munn and the Secretary.

Mr. Horsnaill, of Dover, then read a paper on "Preparing and Mounting Insects for the Microscope," entering fully upon the best methods, and explaining them clearly to an attentive audience. He also brought his microscope and a beautiful collection of slides, so that the remainder of the evening passed pleasantly away.

August 12th.—Field Day. Twice had appointments been made for a day out of doors, and twice had the weather forced the members to relinquish it. To day, however, was more favourable, and along the dusty roads beneath the burning heat of the August sun, the members drove to a meet at Lyminge. The Rev. Canon Jenkins, whose name is familiar to all archæologists, had kindly invited them to an inspection of his venerable church, and placed his grounds at their disposal for tea. On their arrival he conducted them into his library, where half an hour passed rapidly away in scanning over ancient volumes, manuscripts, and illuminations. They then proceeded to the church, accompanied by Mr. Jenkins, who explained every part of the building, which is one of the oldest in the country, dating back from the early Saxon times. The betrothal of Edwin, King of Northumbria, with Ethelburga, is said to have taken place at Lyminge, and the lady is supposed to have been buried here. Most of the members ascended the tower to enjoy the beautiful view obtainable from its summit. All then returned to the lawn of

the Rectory and did ample justice to the tea which had been provided for the occasion. The tea over there was a call for the Secretary to make a few remarks upon ferns, of which there were some good specimens in the garden. This brought the pleasant afternoon to a close.

September 12th.—Evening Meeting at the Museum. The attendance was so small that nothing was done.

October 10th.—Evening Meeting. W. B. Tolputt, Esq., jun. sent a paper on "Dentition among the Lower Animals," which was read for him by the Secretary.

November 7th.—Evening Meeting. There was a large attendance, and the President read a paper on "Darwinism," explaining the theory and stating the arguments in its favour, without however identifying himself altogether with them. The Secretary replied to the paper, and advanced arguments to show that the theory associated with Mr. Darwin's name was in all probability founded on truth, yet it could not do all that its talented author claimed for it, and was but one among other agents, known and unknown, for effecting the changes constantly being wrought out in Nature.

It was announced that the President would commence a Class for instruction in Physiology in the ensuing week; and also that the Secretary would commence Courses of instruction in Botany and Geology. Several members gave in their names to attend.

December 12th.—Evening Meeting. The attendance was very small. Mr. Ullyett read a paper on "Huxley's Theory of Protoplasm, and Objections to it."

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LIST OF BIRDS

OBSERVED IN

FOLKESTONE & ITS IMMEDIATE NEIGHBOURHOOD.

We are indebted to the kindness of Messrs. V. Knight and F. Tolputt for the following list:—

ORDER I.—ACCIPITRES.

FAMILY—*Falconidæ.*

Peregrine Falcon	*Falco peregrinus*
Hobby	,, *subbuteo*
Kestrel	,, *tinnunculus*
Sparrowhawk	*Accipiter Nisus*
Buzzard	*Buteo vulgaris*
Rough-legged Buzzard ..	,, *lagopus*
Honey Buzzard	*Pernis apivorus*

Strigidæ.

Long-eared Owl	*Otus vulgaris*
Short-eared ,, ...	,, *brachyotus*
White ,, ...	*Strix flammea*
Brown ,, ...	*Syrnum aluco*

ORDER II.—PASSERES.

FAMILY—*Laniidæ.*

Red Backed Shrike	*Lanius collurio*

Muscicapidæ.

Spotted Flycatcher	*Muscicapa grisola*

Turdidæ.

Missel Thrush	*Turdus viscivorus*
Fieldfare	,, *pilaris*
Song Thrush	,, *musicus*

Redwing	*Turdus iliacus*
Blackbird	,, *Merula*
Ring Ouzel	,, *torquatus*
Golden Oriole	*Oriolus galbula*

Sylviidæ.

Hedge Sparrow	*Accentor modularis*
Redbreast	*Erythaca rubecula*
Redstart	*Ruticilla phœnicura*
Stonechat	*Saxicola rubicola*
Whinchat	,, *rubetra*
Wheatear	,, *Œnanthe*
Grasshopper Warbler ..	*Calamodyta locustella*
Sedge ,, ...	,, *phragmitis*
Reed ,, ...	,, *arundinacea*
Nightingale	*Philomela luscinia*
Blackcap	*Sylvia atricapilla*
Garden Warbler	*Curruca hortensis*
Whitethroat	,, *cinerea*
Lesser Whitethroat	,, *sylviella*
Wood Warbler	,, *sibilatrix*
Willow ,, ...	*Sylvia Trochilus*
Chiffchaff	,, *rufa*
Gold Crest	*Regulus cristatus*
Great Tit	*Parus major*
Blue ,, ...	,, *cœruleus*
Cole ,, ...	,, *ater*
Marsh ,, ...	,, *palustris*
Longtailed Tit	,, *caudatus*
Pied Wagtail	*Motacilla Yarrellii*
White ,, ...	,, *alba*
Gray ,, ...	,, *boarula*
Tree Pipit	*Anthus arboreus*
Meadow Pipit	,, *pratensis*
Rock Pipit	,, *petrosus*

Fringillidæ.

Shore Lark	*Alauda alpestris*
Sky ,, ...	,, *arvensis*
Wood ,, ...	,, *arborea*

Snow Bunting	*Plectrophanes nivalis*
Common Bunting	*Emberiza miliaris*
Blackheaded Bunting ..	,, *schœniclus*
Yellow Bunting	,, *citrinella*
Chaffinch	*Fringilla Cœlebs*
Mountain Finch	,, *montifringilla*
Tree Sparrow	*Passer montanus*
House ,, ...	,, *domesticus*
Greenfinch	*Coccothraustes chloris*
Goldfinch	*Carduelis elegans*
Siskin	,, *spinus*
Linnet	*Linota cannabina*
Lesser Redpole	,, *linaria*
Mountain Linnet	,, *flavirostris*
Bullfinch	*Pyrrhula vulgaris*

Sturnidæ.

Starling	*Sturnus vulgaris*

Corvidæ.

Raven	*Corvus Corax*
Carrion Crow	,, *Corone*
Hooded ,, ...	,, *Cornix*
Rook	,, *frugilegus*
Jackdaw	,, *monedula*
Magpie	*Pica caudata*
Jay	*Garrulus glandarius*

Certhiadæ.

Creeper	*Certhia familiaris*
Wren	*Troglodytes vulgaris*
Nuthatch	*Sitta Europea*

Upupidæ.

Hoopoe	*Upupa epops*

Alcedinidæ.

Kingfisher	*Alcedo ispida*

Cypselidæ.

Swift	*Cypselus apus*

Hirundinidæ.

Chimney Swallow	*Hirundo rustica*
Martin	" *urbica*
Sand Martin	" *riparia*

Caprimulgidæ.

Goatsucker	*Caprimulgus Europeus*

ORDER III.—SCANSORES.

FAMILY—*Picidæ.*

Great Spotted Woodpecker ...	*Picus major*
Green " ...	" *viridis*
Lesser " ...	" *minor*
Wryneck	*Yunx torquilla*

Cuculidæ.

Cuckoo	*Cuculus canorus*

ORDER IV.—COLUMBÆ.

FAMILY—*Columbidæ.*

Ring Dove	*Columba palumbus*
Rock "	" *livia*
Turtle "	" *Turtur*

ORDER V.—GALLINÆ.

FAMILY—*Phasianidæ.*

Pheasant	*Phasianus colchicus*

Tetraonidæ.

Partridge	*Perdix cinerea*
Red-legged Partridge ...	" *rufa*
Quail	*Coturnix communis*

ORDER VII.—GRALLÆ.

Family—*Charadriidæ.*

Great Plover	*Œdicnemus crepitans*
Golden Plover	*Charadrius pluvialis*
Ringed Plover	,, *hiaticula*
Lapwing...	*Vanellus cristatus*
Oystercatcher	*Hœmatopus ostralegus*

Ardeidæ.

Heron	*Ardea cinerea*

Scolopacidæ.

Curlew	*Numenius arquata*
Green Sandpiper	*Totanus ochropus*
Common ,, ...	,, *hypoleucus*
Woodcock	*Scolopax rusticola*
Common Snipe	,, *gallinago*
Jack ,, ...	,, *gallinula*
Dunlin	*Tringa variabilis*
Purple Sandpiper	,, *maritima*
Gray Phalarope	*Phalaropus lobatus*

Rallidæ.

Land Rail	*Crex pratensis*
Baillon's Crake	,, *pygmæa*
Water Rail	*Rallus aquaticus*
Moorhen	*Gallinula chloropus*
Coot	*Fulica atra*

ORDER VIII.—NATATORES.

Family—*Anatidæ.*

Brent Goose	*Anser Brenta*
Wild Swan	*Cygnus ferus*
Bewick's Swan	,, *minor*
Wild Duck	*Anas Boschas*
Teal	,, *crecca*
Wigeon	,, *Penelope*

Velvet Duck	*Oidemia fusca*
Scoter	" *nigra*
Goldeneye	*Fuligula clangula*
Redbreasted Merganser ...	*Mergus serrator*

Colymbidæ.

Little Grebe	*Podiceps minor*
Blackthroated Diver ...	*Colymbus arcticus*
Redthroated "	" *septentrionalis*

Alcidæ.

Guillemot	*Uria troile*
Little Auk	*Mergulus alle*
Razorbill	*Alca torda*

Pelicanidæ.

Cormorant	*Phalacrocorax Carbo*
Gannet	*Lula Bassana*

Laridæ.

Common Tern	*Sterna Hirunda*
Lesser "	" *minuta*
Black "	" *fissipes*
Little Gull	*Larus minutus*
Blackheaded Gull	" *ridibundus*
Kittiwake	" *tridactylus*
Lesser Blackbacked Gull ...	" *fuscus*
Great " " ...	" *marinus*
Common Gull	" *canus*
Herring "	" *argentatus*
Common Skua	*Lestris cataractes*
Richardson's Skua	" *parasiticus*

Procellaridæ.

Forktailed Petrel	*Thalassidroma Leachii*
Storm "	" *pelagica*

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FIRST SERIES.

PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

October, 1883—August 1884.

FOLKESTONE:
J. English, Printer, 31, High Street.

Nat. Hist. Society
Folkestone. Feb. 6/86

Dear Sir

I have great pleasure in forwarding to you copies of our Proceedings. We work in a limited & humble way, our efforts being mostly directed towards cultivating a love of Natural History & an interest in our own neighbourhood. We have but one or two however who do any active work in our locality.

I also send a copy of a little local work of my own, if you think it worth a place in the Library.

Yours very faithfully
Hy. Ullyett
Hon. Sec.

(Over)

FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS OF THE SOCIETY.

October 9th, 1883.

The First Ordinary Meeting of this Session was held at the Town Hall, on October 9th, at 8.15 p.m. The President (Dr. Fitz Gerald), was in the chair. The Secretary, who had only lately recovered from a long and dangerous illness, was absent through temporary indisposition. There was a large attendance, and the President read the following paper on

THE HAND CONSIDERED AS AN ORGAN OF EXPRESSION, OR SCIENTIFIC CHIROGNOMY, AS OPPOSED TO CHIROMANCY.

It is a curious and interesting question, to what extent, and by what means, certain physical attributes become associated with certain mental characteristics. Every one would be disposed, broadly, to admit the connection between, for example, the development of the brain, and the mental capacity of the man; and few probably would deny a certain significance to the expression of the countenance; but when we fly to the more minute details, we seem at once to enter the domain of unscientific speculation, or undisguised charlatanism. Yet there are deep and undeniable truths

concealed beneath the mystic doctrines of phrenology as well as under the more popular theories of physiognomy.

If then mental attributes impress themselves on the features and modify the shape of the brain, as all must admit they do, why should they not lead, in course of time, to changes of development in the muscular and bony structures? These considerations must be my excuse for introducing to your notice to-night a subject which has for hundreds of years been shrouded in mystery and charlatanism. I allude to chiromancy, or the art of predicting the character from the appearance and development of the hand. This art dates back to the earliest recorded ages of the world, and was inextricably associated with necromancy and astrology.

As early as 428 B.C., an elaborate essay on chiromancy and palmistry was written by Anaxagoras. If we consider the important part played by the hand in giving expression to the emotions in all parts of the world and by all people, whether savage or civilized, we shall not be surprised if it becomes impressed by these constantly recurring and identical movements, both in its muscular structure and bony development. How much does an Italian, a Frenchman, a Spaniard, or even a savage express by his hand. Assent, dissent, fear, surprise, horror, doubt, shame, are all unmistakeably pourtrayed by the various movements of the hand. Even with us phlegmatic islanders the hand is clenched in passion, expanded in joy or surprise, raised in warning or reproof, and made to express the tenderest emotions of youth or the calmer friendship of age. Confidence, trust, joy, are expressed by the open hand, as may be seen by the meeting of old and trusted friends, who advance with open and outstretched palm; while the same movement may be observed in grateful prayer. The closed hand and hidden palm is not less expressive of doubt, anger, concealment, or suspicion. The honest man comes frankly forward with outstretched arm and open palm, the deceitful man glides up to you with arms lank and drooping, the palms turned inwards and concealed. If you notice you will see the man who is trying to "wheedle" or deceive, invariably conceal his palms; he presses them together and rubs them gently the one over the other! Again, in anger, how expressive is the action of the hand! As the "angry passions rise" the fingers begin first to twitch, then contract, until, as temper gets the better of reason, the fingers are clenched convulsively on the palms, and the explosion of rage occurs. What wonder then that the sensitive and flexible palm becomes impressed with lines indicative of these oft recurring emotions. If the same emotion, or train of thought, produces constantly identical muscular contractions of our hands, it is not difficult to believe that they form or modify certain lines on our

palms, and that these may be even transmitted to our descendants. This is what I understand by chirognomy, or the legitimate deductions from scientific data as distinct from chiromancy, which professes to unravel the present and reveal the future. That the science of chirognomy (or the laws legitimately deducible from the structure of the hand) should have become degraded by association with superstition and imposture, is only a fate which it has shared with astronomy, chemistry, and even medicine. The hand is the great exponent of the universal sense of touch. All our senses may be considered as modifications of the sense of touch. Thus the rays of light touch the sensitive retina of the eye, the waves of sound touch and thereby excite the nerves of hearing, the particles emanating from odorous substances touch and impress the nerves of smell and taste, and these all important nerves of touch are more highly developed and more sensitive in the hand than in almost any other part of the body. It would then indeed be strange if so important an organ as the hand were not more or less modified by the mental characteristics of the individual. This truth was well known to the ancient Greek sculptors, as one may perceive by the care with which they accord the characteristic hand to each individual statue. Practically we may consider the hand as divided into the palm and fingers. The palm may be looked on, roughly, as the animal, the fingers are the intellectual part of the hand. The more the palm predominates over the fingers, the more animal will be the nature. This is well shown in the diagram of the hand of a gorilla. Who has not noticed the widely different feel of different palms, and the diversity of impressions conveyed to us by the touch of various hands. There are some whose touch immediately suggests confidence—we feel we can trust the owner There are again others from whose contact we involuntarily shrink, and feel inclined to wipe our own hands. The warm, soft, elastic, satiny palm, is the invariable index of youth, health, and sensibility, while the hard, harsh, hollow palm is no less certain evidence of the reverse. There are great differences of palms; they may be hard or soft, large or small, flexible or inflexible, moist or dry, hollow or flat, smooth and silky, or rough and harsh. According to Mr. Beamish, a "thick hard palm is indicative of the animal instincts; if thick and supple, of emotion and sensibility. If proportioned to the fingers, but hard and non-elastic it is the index of laborious stolidity; if hard but elastic, of laborious activity; if soft, of indolence and tranquil enjoyment; if flexible, an appreciation of pleasure derived from the senses; if elastic, of activity of the mental faculties; if hollow and firm, of mental vigour." "The hard hand may experience a strong feeling of attachment, but exhibit little tenderness, while the soft

hand may exhibit tenderness with only moderate attachment." It is in the palm, says Desbarrolles, that "the warmest feelings of affection find their inarticulate expression."

If there are diversities of palms, still more are there differences of fingers. Some are smooth, others enlarged at the joints or knotted, some have spread out or spatulous ends, some square, others pointed; some are round in section, others square. That these differences of structure are indicative of varieties of race, culture and temperament cannot, I think, be questioned; that they mean all their French exponents would have us believe is a very different matter! For instance I believe the large firm hand with square or spatulous finger tips, and more or less knotted joints, to be unquestionably the type of the practical, mechanical, and industrial hand. While the soft, tapering, pointed, smooth fingers are not less indicative of the poetical, artistic, and cultivated hand. England, Scotland, Germany, Norway, and Sweden, are specimens of the square practical hand. Italy, France, and Spain are examples of the pointed, smooth, tapering, or artistic hand. But M. Desbarrolles tells us these differences mean much more. "Should the first joint (or phalange) of the first finger be pointed, it indicates a tendency to religious contemplation and spiritualism; if square, to the practical in life and the formal in religion; if spatulous, a perturbed unquiet spirit. The second phalange is the index of ambition; third of pride and desire of command." The second finger is supposed to be more indicative than any other of the character of its possessor." Should it be pointed (as it seldom is) it indicates vanity, and if the thumb be also short, frivolity. If square, it means a mind practical and useful. If spatulous, a tendency to despondency and gloomy views of life." The third finger (ring) is the index of art; if pointed, it is indicative of intuition, or sometimes garrulity; if square of defined art and truthfulness of expression. If spatulous it denotes action and dramatic tastes." The little finger is the index of abstract science and numbers. If the first joint is long and oval the conceptions will be intuitive and the love of science strong. If pointed there will be scientific doubts. If square, it shows a love of research and practical discovery. When spatulous it indicates mechanical perfection or stirring eloquence." It is said a peculiar movement may be observed in those who exercise much artifice and address; the little finger is is then separated entirely from its neighbours, and distinctly elevated. Smooth fingers, generally speaking, indicate inspiration, passion, while knotty fingers show habits of order, arrangement, and intuition; induction. When the first joints are distinctly pronounced, Desbarrolles says it is indicative of independence of thought, philosophical doubt, self-confidence, and aptitude for the exact

sciences; he therefore calls it the philosophical knot. Full middle joints mark an appreciation of physical order. Knowledge is quite differently acquired by the possessors of smooth and of knotted hands. Impulse and intuition characterise the smooth, as may be observed in poets and artists; analysis and induction, the knotty, as in mathematicians and men of mechanical genius.

But if the development of the fingers is important, still more is the appearance of the thumb in the doctrines of chirognomy." "A small thumb is generally the sign of weakness, irresolution, and vacillation; combined with a soft palm it shows an accommodating and affectionate spirit." The large thumb, on the other hand, is indicative of "a strong will and little general sympathy." "The heart is in subjection to the head." Idiots and people of weak intellect have invariably small thumbs, while in the monkev the thumb extends no farther than the root of the first finger. The development of the thumb modifies, or is modified, by the appearance of the rest of the hand; thus if the palm be soft and the first joint of the thumb long, the individual will labour, not from love of work, but from a sense of duty, the inert tendency shown by the soft palm being negatived by the force shown by the long thumb. The first phalange of the thumb is the index of the will. Beware of a man with a long strong first joint! for it is indicative of "a powerful energetic will, great self confidence, and a desire for domination sometimes amounting to tyranny!" If the second joint be long and strong, "logic and reason prevail over impulse and will;" if equal in length, there will be some comfort, for then reason will guide and modify the domineering influence of the first phalange. The root of the mound is called the "mound of Venus," and is supposed by chiromancers to preside over the domestic affections. If the section of the fingers be square, as it generally is in men, it is indicative of "openness and candour," if circular, "of a certain reticence and unwillingness boldly to express the thoughts." In the female hand, says Mr. Beamish, the circular form prevails. Short fingers, we are told, "are apt to form hasty and unsound judgments." As artists their possessors are incapable of working out the details, the result must be broadly obtained. Long fingers, on the contrary, are irresistibly drawn towards minutiæ and detail, they prefer the minute to the grand, and are invariably great sticklers for correctness in dress and costume. Nor is the hardness or softness of the hand without its significance in hands having other characteristics in common. Thus a soft hand conjoined with square or spatulous fingers may enjoy "moderate exercise or exertion, but prefers to witness energetic action in others, while the hard palm delights in personal displays and strength. The hard hand cannot be idle; it must always be

doing; it is the practical useful, hand. The soft hand is the hand of the poet, the musician, the artist, the dreamer; who may attain to excellence and fame, but by intuition rather than by energetic labour.

We come now to the more debateable and less scientific part of my subject. There can, I think, be no question as to the general conformation, or even, probably, the more characteristic of the lines of the hand, corresponding, broadly, to the habits, race, and temperament of the individual, or that these characteristics may be transmitted to descendants. No one, for example, would fail to perceive the difference between the hand of the day labourer, whose ancestors had delved the soil for generations, and that of the hereditary peer, whose delicate hand had never touched a spade, But when we come to the mystic operations of chiromancy we are on far less certain grounds, and if I venture into the realms of superstition (for it is nothing less) you must not imagine I believe, or wish you to believe, the mysterious teachings of chiromancy. I enumerate some of them to-night for your amusement, and with the same feeling of interest with which I might follow the researches of the ancient alchemist in his vain search for the philosopher's stone. I say vain search, but it was really far from that, as the numberless experiments of the alchemist led to some of the most useful and important discoveries in chemistry; and as the wild dreams and observations of the astrologer were the foundation of the very practical science of astronomy. I shall quote more largely from D'Arpentigny and Desbarrolles, the great French masters of chiromancy, and from Mr. Beamish, their learned English expositor. On most palms may be found, more or less distinctly marked three principal lines; the first arises near the junction of the first and second finger, and passes in a curved line with the concavity upwards, to the outer edge of the palm about one inch below the root of the little finger. This is called in the language of chiromancy, "the line of the heart." The second line runs diagonally across the palm from midway between the base of the thumb and first finger and terminates in the fleshy part of the external palm (the mound of Mars). This is "the line of the head." The third lines runs around the fleshy prominence of the root of the thumb (the mound of Venus). It arises from the same place as the line of the head, and is lost near the wrist. It is the line of life; great stress is laid on the colour, continuity, and appearance of these lines, and especially if they be crossed by others. When the line of the heart has a uniform and health appearance and colour, it indicates "an affectionate and happy nature," the force or feebleness of attachment being in direct proportion to the length of the line; should it

be broken it indicates "inconstancy in friendship, and a contempt for females amounting to rudeness." There are many other indications connected with this line, its redness, or paleness, direction of its cross lines, width, depth, &c., &c., which mean all sorts of wonderful things bearing on matters connected with the heart, but which I must leave you to study for yourselves under the guidance of M. Desbarrolles, as they are of too sentimental and frivolous a nature for our austere society. I may mention, however, that if this line be bifurcated, and one branch ascend to the index finger, it is the sign of tranquil happiness. A hand destitute of the line of the heart "is not only devoid of sympathy, but is indicative of of bad faith." The line of the head begins midway between the thumb and fore finger, and runs diagonally across the palm. "When direct and well developed it indicates sound judgement and a lucid understanding; if very extended and straight, an extreme degree of economy and love of money. Should it descend suddenly towards the mound of the moon, it signifies prodigality. Should it form a decided cross with the hepatic line there will be a strong tendency to mysticism and superstition; if pale and broad, "a defect in intellect and want of circumspection." If it extends only to the middle of the palm, it signifies "indecision, feebleness of will." Other peculiarities are supposed to indicate injuries to the head, a tendency to homicide, &c., &c. If this line bifurcates, one line proceeding onwards and the other downwards, it signifies self-deception and hypocrisy. If it be long, thin and ill defined, it indicates "bad faith and infidelity," and so on. The line of life surrounds the base of the thumb; if well formed, of good colour, and surrounding entirely the root of the thumb, it indicates "a long and happy life, devoid of any grave illnesses." When pale and broad, it is the index of bad health, and an unamiable disposition." When large and deeply coloured, violence and brutality. When livid with red spots, passion and fury. Lines arising from the line of life and tending upwards, indicate aspirations of the mind towards elevated objects. When this line presents an irregular form, *i.e.* more marked in some places than in others, it is indicative of unequal temper and anger unrestrained."

There are various "accessory lines," especially three arising at the lower part of the palm, and diverging in a fanlike manner as they ascend. These are the lines of Saturn on the thumb side, Apollo in the middle, and the hepatic, or liver line on the outside. When the line of Saturn proceeds from the line of life it partakes more or less of its qualities, and then its different appearances indicate the same things. When it proceeds from the wrist and ascends in a direct line to the root of the middle finger it is indicative of much happiness. Should it penetrate and ascend into the

lower phalange, it becomes the index of a high destiny remarkable for good or evil. When it is broken it indicates uncertainty in attaining success. The line of Apollo, or the sun, if distinctly defined, signifies a desire for celebrity and love of the arts. The hepatic or liver line ought to interest us if there were any truth in chiromancy, for we are told if it is well defined and of a good colour, it indicates sound health, harmony of the fluids (whatever that may be), rich blood, excellent memory, a good conscience, and success in business. If undulating and tortuous, it is indicative of liver derangements and doubtful honesty, which two I can quite conceive might well go together. Cross lines generally indicate defects. Thus on the mound of Jupiter, they signify superstition, pride, egotism; on Mercury, a tendency to pugnacity and violence; on the moon, to sadness, discontent, and morbid imagination; all which qualities are plainly traceable to the supposed attributes of the heathen deities after whom they are named. Transverse lines always indicate obstruction; the most perfect line is spoilt by another running across it. I might go on all night if I enumerated the different significations of all the lines, crosses, mounds, &c., of the hands, and the qualities to be deduced from their smoothness, colour, prominence, and various other appearances—enough, if I have pointed out to you the few grains of wheat in all this bushel of chaff, and showed there is something to be learnt, some truth to be gleaned, even from the mysticisms and absurdities of chiromancy.

November 13th, 1883.

The second ordinary meeting was held on November 13th, at the Town Hall. The following paper was read by Dr. Tyson, on

PAIN.

Pain, perhaps many of you have thought, is hardly a fit subject to bring before the members of the Natural History Society, and to you who have considered it from only a moral point of view, I admit that it is not, and I think would be better treated in a sermon; but pain has a very important physical bearing—known to most of you unhappily—and it is to this part of my subject I shall mainly speak this evening. What is pain? In the first place, pain of whatever kind has its seat in the brain, and without the latter there is no such thing as pain. For instance, if certain

parts of the brain which govern sensation be destroyed, or if by the administration of an anæsthetic, such as chloroform, the functions of the brain be suspended, pain ceases to be felt. When a finger is cut, the pain is not really felt at the injured part, but is perceived as such in the brain, for a communication is sent from the irritated cut nerve, up through the nerves of the arm to the spinal cord, thence to the sensory part of the brain; here the sensation of pain is perceived, but is referred to the finger. If the irritation of the divided nerve be kept up by the retention of any foreign body, such as dirt, the pain will be continuous. Many of you know by experience that as long as a fly or a grain of dust remains under the eyelid, the pain does not cease. But there is another kind of pain, not physical, but moral or mental pain, often harder to bear than the former; these two kinds of pain, although often overlapping each other in their origin and progress, yet must more or less be considered apart; and as I have already stated, it is the physical side of pain which will mainly occupy us this evening.

In considering the severity of pain, the individual must be taken into account; physical pain has much to do with physical sensibility; where the latter is not highly developed, and the intellectual capacity low down in the mental scale, pain is as a rule much less felt. I have seen labourers put up with an amount of suffering which to a highly educated and refined person would be unbearable, and where mental suffering is concerned, the difference is often more marked; and so, although education and pleasant surroundings may bring many pleasures, they nevertheless increase the capacities for suffering.

A writer in the *Pall Mall Gazette* on Malingering, stated some years ago "that he had known one (a malingerer) stumble under a cart wheel, and thus secure a broken leg -the more welcome since the fracture was compound, and promised to keep him many months under the surgeon's hands." He goes on to say, "I have known others thrust their hands and feet into machinery, and at times even to lay open a muscle, or lop off a finger or toe. Not long ago I saw a farm labourer of middle age, whom four months of a hospital had enamoured of that kind of life, and who had just cut off a finger with a hedging bill a few days after his restoration to liberty and work, doing this in order that he might return to the hospital. When the mind is much engaged, or in a state of excitement, injuries may be almost if not quite painless; many men have gone through a battle and have only discovered their wounds at the end. When we cut ourselves, although it may be deeply, the pain is rarely a noticeable feature, because of the quickness of the process and the unpreparedness of the mind. I once attended a boy who fell from the top of a house in Longford Terrace into the

area below, smashing his ankle. He told me afterwards that the accident at the time gave him no pain whatever, and until he was removed he was unaware of any injury.

"Pain in a certain sense is entertaining" has been quoted as an expression of a confirmed invalid. It is this entertaining property of pain for non-oversensitive natures that is alluded to by Leopardi. "What remedy," asks Tasso "is there for weariness?" "Sleep, opium and pain, replies the Spirit, and this last is the most potent of all, for while a man suffers he can never feel weary. Then speaks out the sensitive nature in Tasso. "I had rather be wearied all my life than take this medicine." Shakespeare says, "He jests at scars who never felt a wound."

It has been said, and I think with good reason, that our martyrs did not suffer the intolerable physical anguish that many people have ascribed to them; for their minds were intensely fixed on other things. Doubtless there are many people who receive credit for bearing much pain when they experience little, and again, others receive little sympathy whilst suffering much, and it is for the reason that there exist such numerous grades of sensibility that corporal punishment must necessarily ever be disproportionate in its action. In speaking about pain in the lower animals, I do not wish to say anything that would underrate their real sufferings, but at the same time, I do firmly believe that animals are thought to suffer a great deal more pain than they generally do. We must remember that pain is entirely associated with the nervous system, and that the less this is developed in the animal scale the less sensitive is the animal. Several examples of this little sensitiveness of pain might be given. The following are interesting:—A horse will eat grass with a broken leg with comparative comfort. A badger will overturn a nest of wasps, and remain eating the honey and larvæ, wholly indifferent to the abundant stings to which it is treated; and we believe monkeys will sometimes sit and gnaw their own tails, provided they are not prehensile tails. We read of a gentleman who had to keep his monkey's tail covered with tobacco juice in order to prevent this destructive process, while, as regards crabs and lobsters, even a fright will sometimes cause them to throw their claws away. Look at the immense murder which goes on amongst the animals low down in the animal scale. Cries of animals must not be confounded with the moans of pain; the two are entirely different and have different meanings. A dog always cries out before he is hurt. There is always a compensatory action existing in all forms and stages of life, and as we suffer more acutely than our animal friends, so are our opportunities for shielding our suffering greater; reason and experience teach us many ways of easing ourselves, but of this more anon.

Coming now to the main part of my paper—the uses, oars, some would say, the uselessness, of pain—I find that my difficulties increase, for opinions are conflicting when few authors take the same road, and yet perhaps in many cases these difficulties are more apparent than real. But let us now for a few moments look into some of these.

Mr. Hinton, who has written a well-known pamphlet, entitled the "Mystery of Pain," takes up the spiritual or moral side, and thinks little of the use of pain unless bearing upon this.

Dr. Yeo wrote an article in the *Contemporary Review* for July, 1879, taking what be called the material side, and stating that pain in itself is of very little, if of any value. Having read both these papers, and some others, also having given the subject some little thought, I believe the truth concerning the use of pain to touch both the above extreme views, but the bulk of it to rest principally between the two. It is not becoming to speak much here concerning the moral side; a few sentences will suffice. Most people will admit that pain watched increases our sympathy and gives us larger hearts; the pain and discomfort of many animals draw us to them, and teach us to care for them. Hinton goes as far as to say that "A life from which everything that has in it the element of pain banished becomes a life not worth having; or worse, of intolerable tedium and disgust;" but the nature of the individual will determine very much the value that will be put upon this moral side of the subject. Let us turn to the other side.

The existence of pain anywhere seems to be an abnormal thing, and wherever it exists a cause for it must be present, although in many cases we are unable to discover it.

Many examples of the use, and also, as far as we can judge of the uselessness of it, might be given, but as this paper is not a medical essay, my examples will be few. Pain in some diseases acts as a warning and attracts attention indicating that rest or some other remedy is required, and often when this indicator has been neglected serious troubles have followed; but on the other hand pain does not take the van in a large number of diseases, and many diseases have progressed considerably before that pain has called attention to them.

In these last diseases, pain is not to be blamed—as she has been—for failing to act the part of a sentinel in the on-coming disease, for other symptoms or signs have already existed telling the nature of the complaint without the unwelcome addition of the pain. Again, the severity of pain is no gauge for the severity of the disease. Many of our most fatal diseases run through their course with little: and *vice versa*, many painful complaints interfere little with length of life.

Pain depends upon the amount and the quality of the nerve structure that is involved ; a growth not larger than a pea may produce more pain than one weighing a pound, providing that it is in contract with a nerve, and a certain amount of pressure be maintained.

It would be interesting to follow out the discoveries that medical science has discovered for the relief of pain, but a mention of these must be sufficient. For producing general anæsthesia we have chloroform, ether, nitrous oxide, &c. ; for local anæsthesia we can use either, and for local pain we have the inumerable preparations of opium, &c., &c, It is often said that we do not value a thing until we lose it. Well, try and imagine what took place before the introduction of chloroform into general use ? Many people died at that time simply for the want of an operation, fearing the agony of undergoing it. Dryden deliberately chose death rather than endure the pains of a surgical operation. Even those who had the courage to put themselves under the knife suffered an amount of pain which seems in many cases almost to have been the cause of death. "Pain may kill," says Dr. Latham, "it may overwhelm the nervous system by its mere magnitude and duration." Although civilization has brought in its train seemingly more pain, yet science has not been backward in finding out many inventions and so robbing pain of half of its terror.

As many people wish the banishment of pain, does it occur to them what condition we should be placed in, if it were so ? We have no hesitation in saying that but for pain neither we nor most of the lower animals could exist. What is it that forces us to care for the body but the fear of pain ? If there were only pleasure and not pain we should destroy ourselves. Think what the result would be, providing that there was no pain. We drop something valuable into the fire ; if there was no fear of the pain should we not pluck it out and at the same time destroy our fingers ? We are going on an excursion ; why trouble ourselves with a weight of food if there were no such thing as hunger ? We wonder how much a miser in the year would spend on food or clothing if it were not that something would accrue even more painful than spending money. The same reasoning applies to the brute world. If lions or tigers had no pain from the lacerating of their skin as they passed through the interwoven jungle they would pass on until they had no skin to lacerate. If any one animal had no pain when the teeth of another tore its muscles and crunched its bones, it might crunch away and no effect be made to prevent it.

It must be noted that it is education and experience, and not instinct. which informs us of the use of pain. For instance, an untrained child will not hesitate for a moment to walk over a high

balcony, being entirely ignorant of the consequences, and so children unless they have been taught or have experimentally learnt, will attempt the most daring things. A child I know, when 18 months old, was slightly burnt with an egg just boiled, and ever afterwards when an egg was offered her, she would acutely say, "Burn, burn!" Some of you may remember a paper that I read on "Instinct" in this same month three years ago. I there tried to show that as animals possess less brain matter than ourselves, and therefore less reasoning powers, so they must have some compensating quality for their protection and living, and this quality is instinct—the lower the animal in the developmental scale, the more is the power of instinct used; the higher the animal in the scale the more are the reasoning powers brought out.

The distribution of pain is interesting, for many parts that are most delicate and require most care are the most sensitive. Take, for examples, the lining membrane of the windpipe and the lungs, for any foreign body that lodges in these parts is quickly expelled if it is by any means possible by the violent cough set up; a grain of dust does not long remain in the eye without calling earnestly out for removal.

I well remember when a boy seeing a man break stones with his hands only, and wondering how it could be done. Physiology has since taught me that the above proceeding need not be a very harmful or painful one. The man, I noticed, had a large mass of very hard skin developed at the inner border of the palm of the right hand, and this mass of skin was painless, and it was by using this as a hammer that he was enabled to break the stones; and so in men or women who do much manual work, the outer or non-sensitive portion of the skin of the palm and fingers becomes thickened, thus protecting the soft sensitive parts underneath; in labourers who use nearly the whole of the anterior surface of the hand, there is a general thickening; in rowers, only those portions of skin which come in contact closely with the oar would be thickened, and again in the harpist's hand, the tips of the fingers are only affected. In this latter case the sensitiveness of the thickened fingers would be diminished if not lost.

The skin forms an entire covering for the body, and one of its uses is to prevent us from being over sensitive—I mean to pain. Those parts which are most covered—providing that there are a sufficient number of nerve terminations and these be of the necessary kind—are the most sensitive; thus we find the tips of our fingers, especially the forefinger, and tip of our tongue are amongst the most sensative parts of our body, and are used frequently when delicacy of touch is required. Pain acts the part of true Conservatism in many things in life. When the laws of health are un-

attended to, ill-health may follow. Eating rich food, drinking too much alcohol, tight lacing, neglect of proper precaution against inclement weather, neglect of proper ventilation, exercise too much or too little, may one and all produce a sufficient amount of pain or discomfort to call for a change in our life. The last use of pain that I shall mention is as an indicator of coming weather. It has long been known that various kinds of weather affect people in various ways—thunder often causes headache, certain winds produce rheumatism &c. ! but the following case has such a practical bearing that will give you an epitome of it. It is taken from the *Army and Navy Journal*, and recorded by Dr. Weir Mitchell, a well known American physician. Captain Robert Catlin, of the United States Army, has for many years suffered with traumatic neuralgia, resulting from the loss of a foot, which was crushed in battle by a round shot in 1864. The total amount of pain as regards duration for the eight years ending January 1st, 1883, was 12,944 hours, or nearly 1-5th of the time ; he has always been free from pain during sleep, so that nearly $\frac{1}{4}$th of his waking hours is occupied with pain. March is the most painful month, January being a close second. Low temperature and high barometer nearly always produce pain, and extreme barometric undulations extending its duration. Eating a meal hastens an attack and intensifies it when on. Intense auroral periods are also believed to produce pain. As the result of the observation of 60 well-defined storms through 10 consecutative months, it appears that the storms announce their coming by the twitching of Captain Catlin's nerver when the storm centre is at a distance of 680 miles. Should the pain be on a day of intermittent pain, it takes on an additional activity just before the increasing shower, and continues 20 to 40 mins.; this will sometimes four or five times in 12 hours. Each little increment of pain seems to bear about the same relation to the showers, as the main attack bears to the storm. It must be a satisfaction to Captain Catlin to know that notwithstanding all his sufferings, his own case will probably open out a wide field for useful information.

Most of us I suppose especially when young, have dreaded the pain of death, and have made up our minds as to what form of death we should like to die ; yet I believe most of you have made a mistake, and have not chosen the least painful. I am now more especially referring to accidental death. Drowning and burning—Two common forms of death—are very often not more painful than having an anæsthetic administered. The water in the one case, and the smoke in the other, quickly produces suffocation, and when this is attained, the subsequent injuries are painless. In many fatal accidents the primary blow has been sufficient to produce insensibility, so that the after effects have not been felt. I simply

mention these few cases to show that after all death is not so unkind in its action as many of us in our younger days have imagined. It was my intention to say something on Euthanasia, but I find that the subject is too long and touches many moral points which are scarcely fitted to be raised before this society, yet I think there are two or three fallacies in connection with death, which should be dispelled. Death, as as a rule, is not painful, for as we approach it our sensitiveness diminishes and actual death is generally painless. Again, the easing of pain, if it does not save life, certainly prolongs it; therefore, whilst we are causing euthanasia, we are not shortening life.

When I began my paper, many difficulties presented themselves, and do so now, yet I trust the paper to you has not been altogether uninteresting nor uninstructive. I have tried to give a fair statement of the subject as far as my time and thought would permit, and those things which have been omitted, I hope will receive due attention in the subsequent discussion.

The attendance was very good. There was a short discussion afterwards, in which the President and others took part.

February 12th, 1884.

The Annual Meeting was held at the Town Hall, the President in the chair. There was a very fair attendance. The Secretary explained the omission of a meeting in either December or January by the impossibility of getting anyone to read a paper. He then read the Statement of Accounts, which showed a balance of 19s. 1d. in favour of the Society.

The President remarked on the fact that the Society was now entering on the sixteenth year of its existence, and he thought it was creditable to it that the number of members still kept up to about one hundred. He knew of many other societies which had started in the town and died out again, but there appeared no bond of brotherhood and kindly feeling so strong as the interest taken in natural history. He then called upon the Secretary to read the following paper on

THE NAUTILUS AND THE AMMONITE.

The relics of bygone worlds! Memorials of that which has been, and which can never be again! Reminders of a time long before man's foot had trodden this earth, members of a creation over which he never had dominion! What curious imaginings pass through the

mind as we attempt to think of a time when this world of ours was a busy world without ourselves! It seems almost impossible to picture out a globe covered with a magnificent vegetation, and inhabited by myriads of creatures—and man, absent. In one of those odd mixtures of science and fiction with which the name of Jules Verne is associated, the author gives an account of an ideal journey into the interior of the earth. The scientific traveller comes into regions are the huge saurians of the Mesozoic Period still battle in primeval seas, and to others where the Megatherium and the Mastodon are browsing on more recent vegetation. But he seems bound to introduce a human companion to them:—

"At a distance of a quarter of a mile, leaning against the trunk of a gigantic kauri, stood a human being, the Proteus of those subterranean regions, a new son of Neptune, watching this countless herd of mastodons, and huger still himself, * * * a giant, able to control those monsters. In stature he was at least twelve feet high. His head, huge and unshapely as a buffalo's, was half hidden in the thick and tangled growth of his unkempt hair. It most resembled the mane of the primitive elephant. In his hand he wielded with ease an enormous bough, a staff worthy of this shepherd of the geologic period."

For we have been for ages so much in the habit of thinking that all creation exists for man, and man only; we have so got into the habit of pronouncing a thing *useless* if it serves no good purpose for ourselves, that we almost refuse to entertain an idea of generations of animals and plants that had nothing whatever to do with our race, but lived apparently only for themselves.

Yet so it was for countless ages, through all those wondrous changes of land and sea which have taken place since.

> "The solid earth whereon we tread
> In tracts of fluent heat began."
> "O earth what changes hast thou seen;
> There where the long street roars, hath been
> The stillness of the central sea.
> The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mist, the solid lands,
> Like clouds they shape themselves and go."

But through it all it was a busy earth, full of life. The records of the past are too evident and too simple to be misunderstood. Nature does not write in hieroglyphs the history of a prehistoric world, the characters may be read of all. written in the rocks themselves.

And certainly, among all the relics glittering at our feet as we ramble across the sea-forsaken bay, none so readily attract our notice as the curious Ammonites, Horn-stones, or Snake-stones.

Glittering in the original hues of their shells, odd beyond all others in their shapes, they seem to call out for recognition. What wonder if they excited the interest and puzzled the minds of men before the science of geology was called into existence. What wonder if they gave rise to legends and traditions which have now become as interesting as the fossils themselves. Snake-stones—what a natural name to give them ; petrified, coiled up, snakes—the readiest explanation of their existence. Curiously always devoid of a head, though this deficiency has often been ingeniously supplied by local fossil merchants. But how petrified in such numbers ? Sir Walter Scott tells us in Marmion how the nuns of Whitby gathered in the evening round the fire, relating tales of the wonders wrought by their patroness. They told how

> Of thousand snakes each one
> Was changed into a coil of stone
> When holy Hilda prayed.

For it appears that the holy maidens who dwelt at the Convent of Whitby were much distressed by the snakes infesting its precincts, and that the abbess at length succeeded in her request that they might be beheaded and petrified. And so there they are at this day to the discomfiture of all who delight in their own incredulity.

Let us pick out a few of them, and question them relative to their origin and history. If we are interested in the half-ruined dwellings of vanished races of men in the uninhabited wilds of America, or the desolate forests of India, how much more so must we needs be in regarding these habitations of a family of creatures that literally swarmed in the early seas. Not a bed of rock or clay from the Severn to the Wash, from the English Channel to the Yorkshire Moors, that does not yield them by hundreds. They boast of an antiquity before which that of pre-historic man fades into nothingness. Frail creatures in themselves, with soft fleshy bodies, they secreted from those bodies the dwellings which still survive.

They belong to the sub-kingdom known to zoologists as the *Mollusca*—a set of animals wholly soft in structure, and with no skeleton whatever— the set which includes our snails, oysters, slugs, cuttlefishes and others of that ilk represented on the diagram. To the geologist this is the most important section of the animal world, for by the traces its members have left behind, he for the most part is enabled to classify rocks. And it is nearly the oldest section too, for the most ancient fossiliferous rocks of Great Britain —those called the *Camorian* give us specimens.

But it is a wide, far-reaching snb-kingdom, and our Ammonites belong to its highest class, the *Cephalopoda*, represented at present by the Cuttle-fish, Octopus, and Nautilus.

And since it is well to study by proceeding from the known to the unknown; to make ourselves thoroughly acquainted with that which is tolerably familiar to us, so that we may the better comprehend that which is new and strange; let me briefly describe the modern Nautilus and its shell, which so much resembles the ancient Ammonite. The Nautilus shell is doubtless a familiar object to you all, but in all probability you never cut one open to examine the interior, perhaps would have rejected the suggestion with scorn, as such a mode of acquiring knowledge is supposed to be peculiar to children in their treatment of mechanical toys. Nevertheless it is a wise proceeding.

But first of all, let me ask you to look upon this modern Nautilus with that respect and reverence which is due to the descendant and representative of an old historical family. I remember reading of some geologist (I believe it was Murchison, but am not sure), who on exhibiting a certain ancient fossil to a friend, said, "Handle it reverently; maybe it is one of the first created things." I might almost say the same of this. Like the Gairfowl on the Allalone-stone in Kingsley's *Water Babies* it "is of an ancient clan," and might say with that grand old lady, "I am the last of my family." For the Nautilus is found fossilized as low down as the Upper Silurian, and some of its close relations lower down still. Those who have read geology know what that means. And it has lived on ever since, well nigh unchanged, though the long vicissitudes of Time, and now wanders through our seas, solitary and without kin. By its aid we shall gain an insight into the nature of our Ammonites.

Well, notice this interior, which one of my students has so carefully cut for me. You would not have expected to find these chambers within, so neatly, smoothly, and symmetrically separated from each other· There are in this specimen 33 compartments, and nothing could exceed the gracefulness of the curves by which one is completely isolated from the other. You might almost imagine that each cell had been the abode of a separate creature, and that the whole shell was a kind of colony or model lodging-house. (And let me remark just here that the interior of many other shells would surprise you just as much if you examined them; one or two are on the table, though they have no connexion with the subject of our lecture).

Now notice the enormous size of the outer compartment; in that, and in that only the animal lived; the others were simply air-chambers which assisted the occupant of the shell in its movements through the waters. Of course originally the first compartment at the centre of the spiral was the habitation of the nautilus; it enlarged its dwelling as its body increased in size; and as it built

its shell forward it manufactured a new partition wall behind, thus making an additional air-cell.

The most curious, as it has been the most puzzling part of the whole structure is this narrow tube which passes through the centre of each partition back to the very beginning. It is nearly all decayed now, but it was a membranous tube known as the *Siphuncle ;* it passes through a little collar formed in each wall, and so was strengthened and supported. We find remains of the same organ in fossil specimens as shown on the diagram. What is its function? And why were the air chambers constructed at all? At first sight they would seem an incumbrance rather than a convenience to the animal. I do not know that these questions have even yet been settled to the satisfaction of Zoologists. We can easily see that the air chambers would reduce the specific gravity of the whole shell and make it lighter for the animal to move with in the water, though they might be a hindrance to it in its descent and in its movements at the bottom. Some have imagined them filled and emptied with water as occasion required, others that nothing but air, or some kind of gas secreted by the animal, was in them. The clearest and most satisfactory account seems to me to be that given by Dr. Buckland in his Bridgewater Treatise. The compartments are true air chambers, completely isolated from each other, from the body of the nautilus, and from the water, therefore they cannot be alternately filled or emptied with anything. The siphuncle is the organ by means of which the specific gravity of the shell is altered. This tube is organically connected with the animal, commencing in a cavity surrounding the heart called the pericardial cavity. This contains a quantity of fluid which can at will be forced into the siphuncle along its whole length, thus leaving the pericardium empty or nearly so, and by so much, increasing the weight of the chamber portion of the shell; or it may be again withdrawn from the tube so as to make it easier for the animal to ascend to the surface, The divisions assist in strengthening the walls of the chambers against the pressure of the waters, on the same principle that the walls of ships sailing on Arctic voyages are strengthened by cross beams against ice pressure.

Thus we see here, as everywhere else throughout nature, an adaptation of the mechanism to the surrounding circumstances—which loses none of its beauty, none of its wonder, whether we look upon it as designed by a direct creation, or as the result of a long evolution from a more primitive form.

A fossil form of nautilus is represented on the diagram, from which we gather that the ancient nautilus in all respects resembled its modern descendant. The same air chambers, the same siphuncle are preserved. The specimen figured illustrates in an admirable

manner the method of reasoning by which the geologist extracts from a fossil its own history. It is *Nautilus striatus* from the lias rock at Whitby, and the interior of the cells is filled exclusively with calcareous spar, while the siphuncle contains nothing but lias mud. This proves that no communication existed between the siphuncle and the air chambers, otherwise the lias mud passing from the bed of the sea through the tube must have found its way into them. Note also that this fossil siphuncle is fractured in two places. These gaps could not have existed when the mud early found its way in, but must have been formed after petrifaction. The spar was introduced subsequently to these fractures by slow infiltration through the walls of the cell, and now it fills the whole cavity. But neither has the spar found its way into the tube, nor has the mud of the tube escaped into the chambers.

The animal itself, as I said, occupies only the outer enlarged chamber (in this respect the fossil represented is imperfect). The substance of the body resembles that of the Cuttle-fish or the Octopus. Around the mouth a number of arms are arranged, but these are not provided with suckers like these of the shelless octopus. The nautilus is seldom seen, being in all probability a deep sea animal; only a few specimens have ever been dissected. It must not be confounded with the Paper Nautilus, which has a ribbed shell much more delicate in its structure, and unprovided with compartments.

We are now, I hope, in a position to understand better the structure and nature of the ancient relations of the Nautilus, whose habitations are distributed so abundantly in the Gault of East Wear Bay.

The Ammonite animal was, in all probability like the Nautilus.

There are two particulars however in which the *Ammonitidæ* are distinguished from the *Nautilidæ*. In the first place the Siphuncle, instead of piercing the centre of each septum, runs round the outside of the coil of the shell, occupying what we call the dorsal position. In every other particular it is like that of the Nautilus, *i.e.* it was membranous, and protected by a sheath or collar at each septum. The second point of difference is more important—the character of the septa by which one compartment is separated from another.

In the Nautilus they are simple and symmetrically curved, the concave side being always towards the mouth of the shell. It is evident that a transverse section of these septa would give a simple curved line. But it is not so in the Ammonite family. While the dividing walls are flat or nearly so in the centre, their edges are angular, folded, or sinuated, so than when they make their impressions on the outer walls of the shell, as they frequently do, they confer upon it a considerable amount of ornamentation. Notice

this on the right hand figure of the diagram representing a Triassic form known as a *Ceratite.* You must distinguish between the actual ribs and projections of the shell wall itself, and these sinuosities which are the edges of the septa. In this example you notice that there is a simple curve directed forwards, towards the mouth of the shell—this is a "saddle"; and then there is an elevation between the saddles directed backwards, known as a "lobe," which is toothed or denticulated. That is the distinguishing mark of a Ceratite. In the true Ammonite both lobes and saddles may be irregular in outline. On the table are two casts of chambers of an Ammonite, by looking at these you will get an idea of their very irregular shape. You will notice too, on comparing diagrams and specimens, that the outer chamber or habitation of the Ammonite differed much in shape from that of the Nautilus. It was much more elongated, and not so expanded in width.

The earliest known forms of the family are found in the Lower Silurian, but in this case the shell was a straight one, not coiled round. Coiled forms occur in the Upper Silurian—the *Goniatite,* which is also found in the Coal Rocks. Specimens are on the table. In that genus the sutures are either simply lobed or shortly angulated, not sinuous. The Ceratite, you see, is an advance upon that form from an ornamental point of view. Of all the *Ammonitidæ* however, the *Ammonites* comprise by far the greater number of species, over 500 being already known. It is characteristically a fossil of the Mesozoic or Secondary Period, commencing with the Trias and ending with the Chalk. Each special rock group is marked by its special set of Ammonites, a bed of clay a few inches thick often containing species found neither above nor below it. These few inches, it should be remembered, represent the lapse of long ages, probably thousands of years, during which these particular forms flourished. When the physical conditions changed the forms of life changed too, and developed into new species. Our own Gault clay is scarcely 100 feet thick, yet it has been divided into eleven beds, technically called "horizons," and nine of these are characterised by peculiar forms of Ammonite.

It only remains for me now to barely allude to a few other chambered shells, more or less distantly related to the Ammonite, and all included in the same family. We find in East Wear Bay a long straight form curved at each end called *Hamites*, a smaller one with the curved end in actual contact—*Scaphites.* In *Ancyloceras* we get one end spiral with separated whorls, and in *Crioceras* a wide open spiral. There are many others but time will not permit me to refer to them. I only trust that I have done something towards rendering your future rambles in the Bay more intellectually interesting than they may have been before.

Mr. Walton in proposing a vote of thanks referred to the necessity of an extension of practical personal work among the members so that the lists of local productions might be made more complete. He hoped the efforts of the secretary would be more heartily seconded.

Dr. Tyson seconded, and made some further remarks on air chambers and air cells in other animals beside the nautilus.

The officers for the ensuing year were then elected, consisting of those of the previous year with the addition of J. Smurthwaite, Esq.

It was afterwards agreed that the March meeting should take the form of a Conversazione, to which members should be invited to contribute any objects of interest for the evening.

March 11th, 1884,

The fourth meeting of the session was held at the Town Hall. About fifty members were present. Microscopes were lent and objects exhibited and described by Dr. Fitz-Gerald, Dr. Tyson, and the Secretary. On the table were fresh gathered specimens of *Helleborus viridis* and various fungoid growths, brought by Mr. Walton, who also exhibited dried flowers. Among these was the Cheddar Pink.

Mr. Smurthwaite brought specimens of coral, and some Egyptian curiosities.

The Rev. T. K. Nevinson showed a fine cone and other vegetable specimens from California.

Mrs. Rumsey exhibited a varied collection of minerals and a case of humming birds.

The Secretary placed on the table a fine specimen of the Hawfinch, lately shot at Newington. Explanations and descriptions were given by various members during the evening, which passed off very successfully.

Tuesday, April 8th, 1884.

The usual meeting was held in the Council Chamber, the President in the chair. There was a large attendance. The Rev. J. Burgess gave an experimental lecture on Electrical Discharge, which was highly appreciated. There was an extensive collection of apparatus on the table and the experiments were quite successful by the aid of a Wimshurst's Machine and a large Induction Coil. Those illustrating discharge in very high vacua were especially interesting as showing how differently Electricity acts under such conditions.

A cordial vote of thanks was passed, in acknowledging which the lecturer kindly expresssd his readiness to assist on any future occasion.

June 24th, 1884.

The sixth meeting was held at the Town Hall, and was very largely attended. The President read the following paper on

EARTHQUAKES AND VOLCANOES.

There is a constant struggle between the forces of earth and water for the dominion of our globe, the earth continually striving to upraise herself, the mighty waters as continually striving to engulph her. Each tiny dew drop, each rippling stream or rushing river, each placid lake or raging billow, are equally bent on wearing away, or grinding down the rocky surface of the earth and burying it beneath the bosom of the mighty ocean. As the bulk of the sea preponderates over that of the raised land in the proportion of nearly three to one, it would be a mere question of time (a few million of years, a mere bagatelle in geological calculations) before the whole of the now raised surface of the world formed the bottom of a universal, shallow ocean, that is to say, always supposing there were no counterbalancing forces in operation. Nor is it water alone which carries on the seemingly unequal contest; the atmosphere, the winds, ice, snow and frost, all aid in the process of disintegration and destruction. And this (by the way) is the reason why the mountains and craters in the moon are so enormous and sharply defined, for there no atmosphere or water exists to disintegrate and wear down their surface. Yet earth has a mighty and unlooked ally in the disguise of a violent enemy; for Vulcan constantly thrusts new land (in ancient times as in the present), above the

level of the overwhelming waters. There is a very general impression that volcanic action was on a grander scale in past geological ages than at present, but there is good reason to believe that "volcanic energy" is a "constant quantity" and that though it changes its scene of action, it does not alter or vary in amount (Judd). Earthquakes are so rare in England, and so comparatively slight, that few of us perhaps quite realise how constant and stupendous are these forces, even at the present moment. It has been calculated (Huxley) that there are certainly not less than three shocks of earthquake a week, and could we obtain records daily from the whole surface of the globe, it would be found that valcanic action was positively unceasing in one place or another. Even in England during the relatively short period of historical times, there have been recorded 500 shocks of earthquake, and, taking the records of the whole inhabited world, no less than 70,000, by means of which many millions of lives have been lost. Earthquakes and volcanoes are generally spoken of as different manifestations of the same explosive force, but I think there are good grounds for believing that, taking into account the cavernous or cellular condition of parts of the earth's crust, caused by the solvent action of water, and the enormous cavities created by the evolution of carbonic acid gas, there must occasionally be tremendous convulsions caused by subsidences of the roofs of these vast caverns, accompanied by terrific reports from the fracture of rocky beds and strata, and that these causes alone would account for many of the vibrations and minor earthquakes and earth-tremblings, apart from volcanic action. Of course I do not for a moment mean to assert that these subsidences would be sufficient to cause the more stupendous earthquakes felt for great distances, for these are undoubtedly of volcanic origin. These gigantic throes, the earth waves and upheavals, are the result of pent-up forces striving to find an outlet. All experience teaches that earthquakes and volcanoes stand in inverse ratio one to the other. I mean that the maximum of one corresponds to the minimum of the other, so that earthquakes are always more violent and numerous immediately before the eruption of the nearest volcanic outlet, an outlet, by the way, often situated hundreds of miles distant. An earthquake may be appropriately described as an earth wave—a billow of solid earth moving, just like a wave of the sea, often with a velocity of from 20 to 28 miles a minute (Humbolt) and with an undulatory motion such as you may see when a heavy carpet is shaken at one end. It has two distinct movements, one vertical, *i.e.*, up and down, the other horizontal; and it is this second linear movement which is so fatal to buildings, for, of course, it operates at right angles to them, tending to rend or overthrow them, as shown on this diagram.

Yet the simile of an ocean billow is hardly correct, for sea waves do not really advance (except indeed the disastrous earthquake water waves), they move simply up and down in closed circles, as you may see a rope do when held at one end. An earthquake is like an air or sound wave, made, as you know, by the alternate compression and expansion of its particles. The upward or vertical shock is most felt just above the centre of disturbance—the "seismic centre" as it is called (*seismos* being Greek for earthquake), and this centre it is possible to discover by carefully examining the lines of fracture in different buildings, and following the horizontal line of vibration until it intersects an upright line. I will make this quite plain by a diagram on the black board. This seismic centre is thus found to be situated at a depth below the surface of from 5 to 30 miles, a distance quite insignificant when we consider that the depth from the surface to the centre of the earth is 4,000 miles. If I draw a circle as large as this board will hold to represent the world, the thinnest line I can make will represent a crust of over 50 miles in depth. As to what is the actual condition of the centre of our globe, there is great uncertainty, and much difference of opinion exists among eminent men of science. When the theory of the condensation of our earth, first from a nebulous or gaseous, and then from a fluid condition was first accepted, it was almost universally considered that the centre was still in a fluid and superheated condition, while the thin outer crust was hard and rigid, just as a circular mass of molten iron would cool and harden first on the outside while the centre was still fluid and hot. But there are astronomical facts which negative this idea. Professor Hopkins has demonstrated, at any rate to his own satisfaction, that the crust of the earth must have a thickness of at least 800 to 1000 miles, and that the whole globe must possess a rigidity equal to a mass of steel of the same size; and the balance of scientific opinion is now decidedly in favour of a solid central nucleus of a ferruginous character. One thing however is quite certain that the temperature increases in direct proportion to the depth below the surface, at the rate of one degree Fahrenheit for every 55 or 60ft., so that at a depth of 200 miles or so, we should reach a temperature of 18,000 deg., "the effective temperature" of the sun, and sufficiently high to liquify and volatilize every known earthly substance, metals, rocks, or crystals. But we must bear in mind that the boiling point of water is much higher under pressure, and that the same rule holds good as to the melting point of metals or rocks, and the superincumbent pressure they must be subject to in the centre of the earth must be something almost inconceivable, and probably sufficient to keep matter solid at any temperature. After all we must remember that we are arguing from very slender

grounds, the deepest boring in the world (at Sperenberg, near Berlin), being only three-quarters of a mile deep, which is a very insignificant distance compared with the 4,000 miles radius of the earth, from which to draw conclusions. Various theories, mechanical, chemical, and electrical, have been broached to account for the undoubted fact of fluid lava, or melted rock at a high temperature, existing beneath volcanic vents; none of them, however, are quite satisfactory. It is presumptuous in me to bring forward a theory of my own when so many scientific men are in doubt on the subject, and yet the thing seems so clear to my mind. Admitting that the temperature rises in geometrical ratio as we go beneath the surface and towards the centre of the earth, we must, of course, soon reach a point at which all ordinary rocks would liquify from the heat, but beyond that point again we should come to a region where the superincumbent pressure would be so enormous as to counteract the effects of the highest conceivable temperature, and from there to the earth's centre all would be solid. So that at a certain depth, which would vary widely according to different physical conditions of pressure, &c., there must exist a layer of liquified or melted rock, which only requires the addition of water to generate steam and became so highly explosive as to force its way through any weak place in the overlying strata. Now it is a curious fact that all volcanoes are situated close to the sea shore, or on islands, and in the one or two apparently exceptional cases they are not far distant from water. It has been argued that volcanoes cannot derive the steam which they generate in such vast volumes during eruptions, from the subjacent seas, because the fissures or rents in the earth communicating with the waters, could only have been *caused* by the eruptive force, so that the communication would only exist *after*, instead of *before* the explosion. But every one knows the enormous distance to which water will percolate through the earth, and it is only necessary to imagine it reaching the liquified rock by this means, to understand the sudden and immense evolution of steam which would take place. If other proof were wanting, it would be found in the fact that fish have been frequently ejected from volcanoes, as well as the chemical constituents of sea water. I am often asked if it is likely we should ever have severe earthquakes in England, and if it is possible for a volcano to spring up in our midst. Of course we might have other and more severe earthquakes than we have yet had, for although they are almost invariably associated with volcanic eruptions, they are often felt at enormous distances from the volcanic orifice, often indeed more severely than near the vent. Nor is this surprising when we remember that earthquakes generally subside in violence as soon as a free outlet is afforded to the pent-up forces. We are

however, well out of any of the direct lines of volcanic energy, though we are, in common with the rest of the world, always liable to the minor earthquakes caused by the falling in of subterranean cavities, and the fractures and crushings of rocks which must necessarily be caused by the shrinking of the earth's crust. As you all know, the earth, which was at one time a molten and glowing mass, has been for countless ages gradually cooling, and is, of course, doing so still. It is calculated by Sir William Thompson that our globe loses each year sufficient heat, or caloric, to melt 777 cubic miles of ice, or to raise an equal bulk of water from 69 deg. Fahrenheit, to boiling point, 212 deg. This cooling is necessarily attended with contraction, and it is this shrinking of the earth's surface which has thrust up the various mountain ranges, just as a withering apple in contracting thrusts up its skin. The same process of contraction must be eternally going on beneath the earth's surface, and must assuredly produce prodigious effects in the shape of heat and motion, accompanied necessarily by earth tremors and vibrations ; in fact by minor earthquakes. As regards volcanic eruptions, however, we have already had our day, in long bygone geological (miocene) times, as evidenced by the volcanic deposits in Wales, the North of Ireland, and several parts of England and Scotland. Snowdon and Cader Idris are both of volcanic origin, as is also the celebrated Giant's Causeway. The way in which volcanic action shifts to different points of the earth's surface is most curious and unaccountable. There is scarcely a spot which has not been visited, while those centres where it is now most active were, in bygone ages, quite tranquil. The whole submarine strata, for example, on which Etna now stands, were in times not geologically very remote, not existent. Nor is any instance known in which volcanic energy, after becoming extinct, has again returned to the same spot. So that, humanly speaking, we may be said to be tolerably safe, being, as I before remarked, out of the direct line of still active volcanoes. A glance at the map I have sketched will show you the curious linear arrangements of volcanoes, which run in a more or less north and south direction. As I have already pointed out, one would expect them to occur on the lines of greatest weakness of the earth's crust, namely, where the ocean bed is depressed and the adjoining land elevated. And you will observe volcano outlets all more or less directly follow the outlines of the two great continents of America and Asia. If we imagine long cracks or fissures running, generally, in a north and south direction, and connected here and there by cross lines (just as might happen in a ball of drying clay), we shall readily understand this linear arrangement of volcanoes, more especially if we accept the theory of water finding its

way to these molten deposits, and supplying the steam necessary for their forcible expulsion through these lines of weakness, and of this latter action there can, I think, be no doubt. That earthquakes may be felt and heard over an enormous area, was exemplified at the fearful catastrophe at Tomboro, where out of a population of 12,000, only 26 were left alive. (Lyell). In this instance the sound was heard at 1,000 miles distance, equivalent to an explosion at Vesuvius being heard in Folkestone; and at Java 300 miles away, the sound was so loud that the frightened inhabitants rushed out of doors, thinking it was an explosion of one of their own numerous volcanoes. The eruption of Morne Garau, in St. Vincent, shook an area of 48,000 square miles, and that of Arica was felt at a distance of nearly three-quarters of the circumference of the globe, while the disastrous earthquake of Lisbon in 1755 was felt over a space four times the size of Europe, that is to say, 700,000 square miles. It was actually perceptible in Scotland, where Loch Lomond rose two feet. These stupendous effects are produced through the medium of the earth far beneath the surface, solid bodies being much better conductors of sound than the air. There must be something pre-eminently mysterious and awe-inspiring in an earthquake. The rocking of the solid ground gives such a violent shock to the imagination as well as to the body, destroying in an instant the unconscious confidence we all have in the solidity of the earth, and shattering in one moment the convictions of a lifetime (Lyell). The hollow and mysterious sounds proceeding from the bowels of the earth have also a peculiar effect on the nervous system (Humboldt). The feeling too of utter helplessness, the knowledge that no presence of mind, no courage, can avail to save, the uncertainty whence or where the danger will come, the rocking walls, the self-tolling bells, and the dumb agony and terror of the brute creation, all combine to complete the horror of the situation. Mr. Coan vividly describes a fearful earthquake at Hawaii, In 1868 the great crater of Mauna Loa while in full activity suddenly ceased to flow. All knew disaster must follow when this vast safety valve was thus suddenly closed. Nor were they mistaken, "for on the 27th March a series of earthquakes commenced, upwards of 1,000 shocks occurring in five days. These continued till April 2nd, when a most terrific earthquake took place, the earth literally staggered like a drunken man. First it swayed to and fro, north and south, then east and west, then round and round, and up and down in every imaginable direction for several minutes, everything crashing down, the trees thrashing as if torn by a mighty rushing wind. It was impossible to stand. Men had to sit on the ground, clinging with hands and feet to keep from rolling over, the ground itself

rose and sank like waves, horses and men were thrown to the ground, and houses destroyed. Crevasse after crevasse opened everywhere, rocks rent, and stone buildings and walls were torn in pieces. At the same time an earthquake wave 20ft. high rolled in foaming fury, along the shore, sweeping away 108 houses, and drowning 46 people. For ten days the earth never ceased rocking like a rocking chair, and trembling as if ague stricken." At last a vent was found, the fiery flood rent open a fissure a mile in length, from which it poured with terrific fury, forming four vast fire-fountains, fluid as water, red as blood; these united into one large stream of glowing lava a mile in length, which rushed madly on to the sea, a distance of four miles, into which it dashed with wild commotion of steam and fury (Gordon Cumming). There is no known force, no disaster, not even the murderous invention of man, by which so many lives are sacrificed in a short space of time as by earthquakes (Humbolt). Naples, alone, in the course of 75 years lost 111,000 inhabitants out of a population of 600,000; at the earthquake of Riobamba nearly 40,000 people perished in little more than a minute, and at Lisbon 60,000 were destroyed in four minutes, 30,000 of whom were congregated in the different churches. One in Sicily overturned 54 cities and towns and 300 villages. Of Catania and its 18,000 inhabitants not a trace remained, and more than 100,000 lives were lost. In 1797 the whole country between Santa Fé and Panama was destroyed, including Cuzco and Quito, 40,000 people were buried in one second. In 1868 the cities of Arica, Arequipa, Quito, and eight other towns in Peru were destroyed, 25,000 lives were lost, and 30,000 rendered homeless; the loss of property was estimated at 60 millions. The most heartrending scenes were witnessed at this last catastrophe, the ground gaping and then again closing, so that many unfortunates were caught by the throat or middle and squeezed to death in sight of their agonised friends and relatives. Others could hear the voices of those dearest to them on earth beneath the fallen *debris* and masonry, gradually getting weaker day by day, while no bribe could procure labour to liberate them, and feeble hands tore in frantic agony at the immoveable blocks in futile efforts to rescue the buried loved ones. Earthquakes have always been associated in popular belief with a sultry, lurid, still state of the atmosphere, and this so constantly that there must be some foundation for the conviction. Yet Humboldt tells us he has experienced earthquakes in fresh, bright weather, and with a brisk east wind blowing. Although the fact is not yet well established, it would not be surprising if volcanic eruptions were, more or less, dependent on atmospheric conditions. We know that the expansion of gases depends largely on pressure, and that a fall of the barometer of

two inches indicates a removal of a weight of two millions of tons on every square mile of the earth's surface Now the relief of so vast a pressure might readily permit superheated fluid to flash into steam (Judd), and produce of volcanic action. The volcano of Stromboli, in the Mediterranean, which has been in constant action for at least 3,000 years, not only serves as a flaming beacon to the seamen of "the Blue Tyrrhenian Sea," but its intermittent vigour is regarded by the native fishermen as an unfailing and trustworthy barometer. The popular notion of a volcano is curiously and elaborately wrong (Judd). It is generally described as "a burning mountain, discharging from its summit volumes of fire and cinders." Now, in the first place, volcanoes need not necessarily be mountains at all, the mountains being only as it were an accidental addition built up by the accumulation of the extruded *debris* of lava, scoriæ, and volcanic products; though certainly some of these mountains are of no inconsiderable size, Chimborazo, in the Andes, being 21,415 feet above the sea level, and Cotopaxi, nearly 20,000 feet high; while Mauna Loa, the far-famed fire fountain of Hawaii, is 14,000 feet above the sea, with an area at the base of 18 miles, while a section through the cone within 1,800 feet of the summit measures no less than 20 miles. Notwithstanding the imposing dimensions of these mountains, all that is really necessary to constitute a volcano is a mouth or orifice communicating with the molten lava below. Then, secondly, the mountain does *not* burn. Thirdly, there are no flames, the fiery appearance, which is often very vivid, being the reflection of the glowing lava within the crater from the steam cloud above it. I say no flames, but occasionally there is seen some luminous hydrogen gas, burning with a faint bluish flame. Fourthly, the glowing lava very often comes from the side of the mountain and not from the top, as was the case in the late eruption of Vesuvius, where it poured from a fissure in the side, 12 miles long; and fifthly there are no cinders properly so called, the extruded lavas bearing no resemblance to carbon, being, in fact, principally combinations of silica, or quartz, as it is popularly called, with the various earthy bases, lime, potash, magnesia, &c., or iron. The porous appearance of the pumice, which you all know is a volcanic product, and with which we are all familiar, is caused by the passage of gases through its mass while still in a semi-fluid condition, just as bread is rendered porous by the bubbles of carbonic acid gas generated by the fermenting yeast. Some of the silicious, or glassy, lavas are blown out into a substance like spun glass, from the forcible passage through it of steam and gas, while still in a liquid form in mid-air. It abounds in Hawaii, where it is called "Pele's Hair," after Pele, the local goddess of volcanoes; it is so soft that birds there use it to make their nests. Another

very constant volcano is Sangy, 17,128 feet above sea level in the Cordileras. This indefatigable mountain has, according to Sebastian Wiss, no less than 269 eruptions every hour, or about one every thirteen seconds (Humbolt). It is often a very difficult matter to say whether a volcano is extinct, or merely dormant, for the 2,000 or 3,000 years of which alone we have any record or tradition count for so little in geological reckoning, that it by no means follows that a crater is extinct because no record exists of any eruption from it. So that it would not be at all surprising if some of our so-called extinct volcanoes were, any day, to break forth into renewed activity. say at Auvergne (in central France) for example. There was not even a tradition of volcanic action connected with Tomboro when it suddenly woke from its sleep of centuries into wild and disastrous eruptions. In Nero's time Vesuvius was considered an extinct volcano, its sides were highly cultivated and covered with flourishing vineyards and an industrious population. It was then an obtusely topped mountain, over 4,000 feet high, with a shallow depression, the old crater, a mile and a half broad, covered with greenery, and overgrown with wild vines, and apparently as peaceful as Sugar Loaf Hill. It was in this picturesque crater that Spartacus the Thracian encamped with his heroic band of gladiators during the servile war. After a premonitory series of earthquakes, which lasted some ten years, Vesuvius suddenly woke into furious activity. The ancient summit, the remains of which are now called Monte Somma, was totally disrupted and blown into the air, and Pompeii, Herculaneum, and Stabiæ, were buried in the dust and debris. Some of this volcanic dust is so fine that Professor Bonney has calculated it would take 25,000 particles to weigh a single grain, and it is so light that it will remain for many days in the air, and is borne by the wind for hundreds of miles. Since that memorable eruption in A.D. 79, when the present peak of Vesuvius was first formed, its shape has frequently altered, being by some eruptions piled up, and by others lowered several hundreds of feet. Lava rapidly cools on the surface, and it is even possible to walk over slowly flowing floods of it without burning the feet. As a curious illustration of what a bad conductor of caloric it is, I may mention that Sir Chas. Lyell relates having seen a large glacier of ice, on the flank of Mount Etna, entirely covered, first with a large layer of fine volcanic sand, and then a sheet of lava, which must have flowed over it, and paradoxical as it sounds, preserved it from melting. It had remained unmelted for at least 30 or 40 years, and afforded a supply of ice to the city of Catania for a number of years. Although volcanoes generally follow the coast lines, the pent-up forces sometimes find a weak spot in the ocean bed, and then ensues a fierce

battle of the elements, as the crater thrusts its burning mouth out of the deep waters, like some fabled fiery dragon of old. It was noticed even by the ancient Romans, Strabo, I believe, that oceanic islands were almost invariably of volcanic origin. A few of these indeed have risen in our own time, for example, Graham's Island, which suddenly appeared in full eruption in the Mediteranean, it was however only three months above water, and during that time it was claimed and named by seven different nationalities! When we calculate that at a depth of 1,000 fathoms the pressure on each individual square inch of the sea bottom is no less than one ton, it explains the fact of so few volcanoes existing in mid-ocean, although the sea holds to the surface of the earth a proportion of nearly three to one.

Closely allied to volcanoes are Geysers, or hot springs, of which I saw excellent examples (probably the best in the world), in Iceland. These are, essentially, water volcanoes; there is the same crater, the same communication with a reservoir of heated fluid, and the same forcible expulsion by the same force, steam. The most remarkable is the Great Geyser, which has a basin or crater as symmetrically formed as though chiselled by art, and a central pipe of 16ft. diameter, whence a body of boiling water is ejected at uncertain intervals some hundreds of feet into the air. There was another geyser on a smaller scale called Strokr, out of which we could always "get a rise" by choking up its funnel with about a small cartload of turf, when, after an interva of a few minutes of sputtering and choking, it would be expelled with the greatest violence, followed by a lofty column of boiling water. You will understand the principle of their action by a diagram I will make on the black board. And yet, disastrous as are their effects, and appalling the accompaniments of earthquakes and volcanoes, their action is, on the whole, beneficial, nor are the fatalities attending them to be compared to the losses from wars, pestilences, and famines. It is generally found that where volcanic action is most frequent the country is most fertile and thickly populated, and although large tracts are occasionally laid waste by eruptions of lava, yet the disintegration of volcanic products makes the most fertile and productive soil, especially for vines. Volcanoes have been well called the "Safety valves" of the earth, for were it not for them the crust of the globe would be constantly shattered and convulsed. But more than all, volcanic energy is absolutely needful to the very existence of our race, by counteracting the levelling influence of air and water, by building up and elevating large tracts of land, thus affording another exemplification, if one were needed, of the ever watchful Providence which so often turns apparent disasters into blessings.

The paper was well illustrated by diagrams and specimens of lava and other volcanic productions. It was supplemented by remarks from the Rev. C. Bosanquet, Mr. Scholey, the Secretary, and one or two others.

August 6th, 1884.

The Session was brought to a close by a Field Day at Lydden Spout, a picturesque spot at the foot of the cliffs between Folkestone and Dover. By the kindness of the S.E.R. Company the 1.24 train from Folkestone halted at the Spout to allow members to alight.

In the course of the afternoon the Secretary read the following paper :—

In the very short paper which I am to read to-day it will be my object not so much to write on any one particular branch or division of Natural History, as to give hints or make suggestions which each mind may follow out as it chooses. The lecture room and the evening meeting are good for summing up and pondering over what has been done ; the field day is best spent by getting a personal practical acquaintance with the facts of Nature for ourselves. To learn *what* to look for, and *how* to look for it, to recognize it when we see it,—not so simple a task as it might appear—and then to put these facts and phenomena together and ask ; What do they mean ?—That I take it is the best way to reap advantage from meetings such as these.

Our locality is, as most of you know, one specially favoured by nature, there is scarcely any branch of Natural History which may not be practically studied at Folkestone with exceptional success. And so it has become, especially to London naturalists, a kind of El Dorado, and all day long, through all the too short summer, we see the geologist's hammer, the entomologist's net, and the botanist's vasculum called into action.

And certainly on the spot where we are now gathered, most of these advantages are concentrated. I have no doubt we shall very quickly resolve ourselves into small compact bodies, each led away by some special study.

To the geologist, to any one who recognises that the earth around him is full of secrets, these perpendicular cliffs must be suggestive of many thoughts—forming, as they do, the very edge, the boundary

walls of our island home. How came those smoothly rounded hills to be thus suddenly and abruptly cut short? And what have they to do with the similarly abrupt walls on the opposite coast? And the mind travels back through the dim and misty ages of the past, questioning as it goes, to days when our island was no island, when it was undoubtedly part and parcel of a continent far larger than Europe is now, and stretching N.W. into the Atlantic no one can guess how far; when probably past this very spot there rolled a great river on towards the east to join the Rhine, which emptied itself then many miles further to the north than it does at present. And we think of the time when there was free communication to and fro, and the ancestors of our present plants and animals travelled across and gained a footing here. For just as our English nation is a mixture of many peoples from many lands, so must our fauna and flora be looked upon as not in the strictest sense of the word "indigenous," not locally "earth-born," but as having invaded us on many sides. The plants give us at this day in Cornwall and the S.W. of Ireland representatives of a Spanish and Portuguese flora; Scandinavian types on the mountains of Scotland and Cumberland, and even Wales; French types in the S.E., while the basis of all, like that of the people, is Germanic. And a similar remark might be made about the animals, but that the extirpation of species for our own convenience has proceeded at a much more rapid rate with them than with the flowers.

The question must often have arisen in the minds of those who think—How did all these animals and plants get here? And the answer to-day is not far to seek. Straight in front of us stretched the broad highway, across which seeds were wafted by primeval winds, and roots wandered year by year, and over which our wild animals found their way in search of food. And not only here to the south but also from the east stretched a great broad prairie land, a plain now submerged through the shrinking of the globe, which, as our late earthquake reminded us, has not even yet ceased; telling its former history by the fossil wood and elephants' teeth and tusks brought up in the fisherman's net.

But then we cannot help going back farther still, and asking the history of this pure white limestone that occurs in such enormous masses over so many hundreds of square miles, well nigh unsullied with sand, mud, or earth of any kind. In what beautiful clear water it must have been deposited, some good distance off shore, and far away from the mouth of any mud-laden stream! What antiquity there is in it! How long did it take to lay down 1200 feet of this chalk? slowly, day by day, year by year, century by century, covering up the remains of the creatures that moved in the early waters. As you know it is all marine, full of the petrified

habitations of animals which could live only in sea water; comparatively free from remains of land animals and plants, few of which could be carried out to deep water before they decayed and were dismembered. The very dust itself into which you crush a bit of chalk is a collection of fairy shells, microscopic, but often wondrously and richly ornamented with that lavishness of beauty so characteristic of Nature.

These chalk deposits cover as I said a very large area; they are found from Ireland all across to the east of Europe, and as far south as Spain. Not, however, in one continuous sheet, but in detached portions. Probably the area was not wholly water, but studded with islands and other masses of land, large and small, upon which of course no deposit could be formed. But in many cases masses once forming a continuous whole have been cut into, and subdivided by the agency of rain and rivers.

The chalk just here is that known as the Lower Chalk, which Professor Geikie in his recent book includes in what is called on the continent *Cenomian.* It is marked by the absence of those lines of flints so noticeable in the cliffs beyond Dover. At its base is the deposit called the Grey Chalk, now so well known through the newspapers in connection with the proposed tunnel. It is very compact, and much freer from joints and crevices than the White Chalk. Hence it is probably the formation through which the tunnel will be driven. A tunnel there will undoubtedly be, some day, when England shall cease to be afraid of invasion, and when the principles that statesmen and scientific men profess that they profess about the brotherhood of nations, shall be principles to be acted upon and not mere opinions.

The whole of the coast between this spot and Folkestone is a kind of undercliff produced partly by gradual crumbling under the influences of frost and rain, but still more rapidly through the action of the land streams working through at various depths where the upper portions rest on a less permeable mass. To this agency have been owing the many landslips, some of which have affected the railway; and those of us who were present on the two former occasions of our assembling here cannot fail to be struck with what has happened in this way since then. Notice that the sea, upon which people generally lay the blame, has had very little to do with the waste here; all it has done has been to clear away the rubbish which has fallen from the cliff. So that it has always seemed to me that a strong sea wall would not in itself do much to stay the waste; it rather wants an effectual system of deep drainage, which would probably be difficult to carry out, and certainly very expensive.

On the chalk rocks lying in the bed of the sea and over which

you can walk from here to Dover when the tide is out, you may find many of those curious excavations known as "pot-holes." They deserve a more æsthetic title, for some are very beautiful. They are worked out by the combined action of the waves and the pebbles—often quite circular, and of all depths from an inch to a foot, the sides clothed with delicate seaweeds, each forming a natural aquarium, in which, after the retreat of the tide you may often find denizens of the sea unwillingly detained.

Just one word in conclusion to the botanist. Only one word because my friend Mr. Walton is more competent to speak upon it than I am, and will, I am sure, as you wander about, be ready with any information you may need. With him you will be able to find the Samphire, the Sea Lavender, possibly (I wont say probably) the Sea-Heath, the Madder, with its prickly foliage, the Beet, the Nottingham Catchfly, and many of the Leguminosœ.

To the Entomologist it will be sufficient to say that I have here taken *D. albimacula* hovering in the darkening twilight over the Silene, and many a larva of *chrysidiformis* from the roots of the docks.

Tea was provided at five o'clock, and the party were taken home again by a train calling for them at 7.30.

Folkestone Natural History Society.

Established for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the summer one or two field excursions are taken.

The subscriptions are of two classes, one five shillings per annum, the other two shillings and sixpence. Anyone wishing to join should communicate with the Secretary, at 84, Dover Road, Folkestone.

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SECOND SERIES.

PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

OCTOBER, 1884—JUNE, 1885.

FOLKESTONE:
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FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS.

SEVENTEENTH SESSION, 1884—1885.

OCTOBER 21ST, 1884.

The first meeting of the Session was held at the Town Hall on this date at 8.15 p.m. Dr FitzGerald, the President, took the chair. No paper was read, but several objects of interest were exhibited, described, and explained.

The Secretary showed two fine specimens of the nest of the Common Wasp, taken at Newington; one of these was laid open to show the curious internal arrangements. He also brought a specimen of the Common Snake, 38½ inches long, taken on the Warren, with eggs of the same.

Mr. Walton showed the Butcher's Broom *Ruscus aculeatus* and *Centaurea Calcitrapa*, together with a Geometer larva, and microscopical objects. Among the latter was a fine section showing the inflorescence of the Fig.

The President exhibited preserved specimens of the edible nest of the Swallow, and of a *Holothuria*, each used as food by the Chinese. The attendance was very fair.

December 16th, 1884.

The second meeting was held in the Council Chamber. The attendance was very good, but rather smaller than usual owing to a grand concert in the adjoining large room. A Discussion on Darwinism was commenced by the Secretary reading the following, short plain and unbiassed account of the theory :—

— DEVELOPMENT. —

It is of the highest importance, before commencing a discussion, that we should understand clearly and exactly what we are to discuss. It is especially so with respect to our subject to-night; because, on no other point connected with science has there ever been such ignorance displayed and such nonsense written by the disputants on both sides. Many a man has spoken and written against Darwin without having ever read his books; many a so-called Darwinian has from his own point of view attacked the views of religious men without knowing at all what religion teaches that has any bearing on the subject. The adherents of Darwin are often more Darwinistic in their ideas than their master, rushing into extreme views, and adopting a style of argument that would never have been countenanced by him—verifying an old adage about the caution of angels and the temerity of other forms of existence, not angelic. And on the other hand the opponents of the great theorist have frequently, and with great ability, argued against what Darwin never advanced, or intended to advance.

Darwin never taught that man was descended from a gorilla (as many people imagine he did) or from any of the present race of quadrumana. And Darwin was no atheist (as many people affirm); he distinctly refers to the acts of the Creator in producing life on the earth.

Again, we must, by way of caution, remember that Development is not a proved fact (as many Darwinians hold); it is *only a theory*, an apparently reasonable mode of accounting for certain phenomena in Nature; one which seems to clear away many otherwise inexplicable difficulties; one which certainly opens up grander views of God's power and mode of working than man has ever before been able to experience. But for all that—*only a theory*; no more an ascertained fact than the existence of atoms.

I know that Darwin's disciples (I say again) have gone much further than he, who knew so much more than they, could go; that one constantly refers to Development as "an established fact"; another affirms that it ought to be taught in schools as a scientific truth; one puts it forth in as offensive a manner as he

can, to throw ridicule on Christianity, while another will give you a genealogical tree showing the ancestors of any species you like. And many of us are familiar with the brilliant articles of Grant Allen in the interests of the theory, in which he will commence with an "if," or a "suppose," and then building on this supposition, triumphantly conclude with Q.E.D.

What then is this Theory of Development? I will make my account as short as is consistent with lucidity.

Everything on the earth, the earth itself, is in a state of constant change; rest and stability are nowhere to be found. Mountains and seas alike disappear in time; summer becomes winter, and winter summer; the climate of a hemisphere changes with the lapse of ages. We dig up here in England the fossil remains of palms, cinnamons, figs, and Wellingtonias which once grew round its old lakes; we find stores of coal embedded in ice on the shores of the Polar Sea; the elephant and hippopotamus once fed on this very spot, and the reindeer has occupied the south of sunny France.

With all physical changes, of land and water and climate, the animal and vegetable world *must* change too, not only their localities. but also in their structure and habits. Any species unable to adapt itself to altered circumstances *must* disappear. It is the riddle of the Sphynx, then, now, and ever—"Do this or perish." When the climate of England was at one time sufficient for the semi-tropical trees just mentioned, and at another was such that every mountain top was swathed in ice, and every valley sent out its glacier as the valleys of Switzerland do now, the species suitable for the former period could not exist in the latter. Consequently they disappeared. And a fresh fauna and flora were established in their stead. This explains the occurrence of the remains of totally extinct animals. The same work is still in progress. The Gair-fowl has disappeared from the earth within the memory of living man, being convinced of the fruitlessness of its struggle for existence. The earth is no longer fitted for it.

Now the point in question is—How did the animals, new to the earth, come into existence? Was there a total destruction of one ancient world of life, and a totally new and sudden creation of another? This was the belief of the early geologists. Or did new forms *gradually* put in an appearance, being *gradually* created (*i.e.* developed) out of the old? coming in so slowly stepwise that no one could ever say when the old form was succeeded by the new. This latter view is what we are considering this evening; it is this idea which has been so industriously worked out by Wallace and Darwin.

If one thing is more certain to the geologist than another in his studies it is this,—that since the appearance of the first form of

life in the world (whenever that may have been) there has been one continuously connected stream of life; no universal destruction, no gap or blank; with the progress of time living forms, both animal and vegetable have multiplied without cessation, both in number and variety. How, again, did the *variety*, the new forms, appear? Were they each individually fashioned, perfect in form and kind, or were several forms developed out of one? The advocates of development adhere to the latter view: *e.g.* that all kinds of elephant have descended from one original form, not exactly like any of them; so with all forms of rhinoceros, hippopotamus, tapir, &c.—that all these various forms may probably have had one common ancestor; that all butterflies have descended from an ancestor probably common to them and to moths,—that indeed all insects have had a common origin; and so with flowers. You will ask upon what grounds such a view has been adopted. I will sum them up briefly.

1.—No two animals or plants of the same kind are exactly alike. There is an innate and unexplained tendency in each to vary from its parent in some particulars more or less slight, in spite of its general resemblance. This requires no proof whatever; you never find two leaves on the same tree, one the exact duplicate of the other.

2.—Such variations can be, and very often are, transmitted to offspring—the latter tends to inherit the peculiarities of its parent. These peculiarities may be either an advantage or a disadvantage, it depends on circumstances around.

3.—More animals and plants are produced than could possibly find room on the earth if they lived what one might call their natural term of life. Therefore many disappear in a more or less abrupt manner. But which of them?

4.—Surely those whose peculiarities were a disadvantage to them. If a variation in certain individuals better fitted them either to obtain food, or to escape from enemies, these individuals would be preserved while the less favoured ones perished. Those that are best adapted to surrounding physical circumstances—they will be the survivors. The carnivore that can catch the most food when it is scarce; the deer that by its longer legs or stronger muscles can best escape the beast of prey; the sheep that has the thickest fleece when climate changes for the worse, &c. This has been happily styled "the survival of the fittest."

Just as man selects those animals and plants best suited to his wants on account of some accidental variation, and breeds from them, thereby artificially producing new *varieties*, if not *species*, so there is a "natural selection" going on around us; some hold merely through the working of a blind law, others, through a con-

trolling outside Intelligence,—which preserves all the varieties best adapted to the surrounding constantly changing circumstances—thereby producing ever new forms in the lapse of ages, and mercilessly converting unadaptable species and individuals into "extinct" forms.

We cannot deny this so far as artificial selection is concerned; new varieties of dogs, horses, pigeons, roses, dahlias, geraniums, are manufactured, one might almost say, every year. And some of these (*e.g.* pigeons) differ so much from each other, that if we had found the kinds wild in a strange country we should unhesitatingly and justifiably have put them down as distinct species.

The question that follows immediately upon this is,—Is there any limit to this variation? Does it only occur within well-defined bounds, or may it go on until we get an indisputably new form, *e.g.* a cowslip from a primrose, a dog from a wolf, or two totally new species of bird from a wild canary?

And here I think I must leave you to take up these questions. I have endeavoured to put the theory before you in plain language without espousing one side or the other.

It must not be forgotten however that our own origin is included in the theory by most though not by all its advocates. Not, as I said at starting, that we are supposed to be descended from any known kind of ape,—gorilla or other, but that they and we are alike descendants of some one ancestor in the far Past who was neither ape nor human, but still Darwin says a "hairy tailed quadruped." This however, would best form a subject for discussion by itself.

The Rev. J. Burgess said he thought that, so far as Mr. Ullyett had gone, they were all agreed.

The Chairman.—Mr. Ullyett has very judiciously expressed no opinion one way or the other.

Mr. Ullyett said his own opinion was that it would be better to place the theory of Darwinism before the meeting, and then some other gentleman could take one side or the other.

Dr. Fitzgerald said Mr. Ullyett had dwelt upon the fact that Darwin was not an atheist; on the contrary, anyone who read his works must have seen that they were written by a man of distinct religious convictions. It was said that science and religion were antagonistic, but he did not think a greater mistake could be made. A thoroughly scientific man must of necessity be a religious man. There was, of course, the objection one could not help touching upon, viz., that the teaching of science and the teaching of the Bible were apparently at variance. This, he believed, to be utterly untrue. The Bible was not meant to teach them science; it was intended to teach them higher and more valuable truths. The holy men whose writings had been transmitted

to them, spoke of spiritual matters only. Mr. Ullyett had also touched upon a fact generally lost sight of by the advocates of Darwinism, that Darwin never said man had descended from the monkey or the ourang-outang. He said that in the past there must have been some type not exactly what they might call human, and certainly not an ape, but a common ancestor from which diverged both the ape tribe and the human family. Any one who had seen savages would not deny that they approached much nearer to the animal kingdom than the civilised world did. There were men who had so little intelligence that they could not count above four, they had no ideas about religion or God, they had hardly any articulate language, they lived on roots, were entirely destitute of clothing, had no notion of washing, or of refinement or civilisation. Surely there was as much difference between a savage and men like Shakespeare and Milton, as there was between a savage and the higher form of ape. There was always the same difficulty about new doctrines They had experienced it in astronomy. When that was first mooted, it was called irreligious, and said to be in contradiction to the teaching of the Bible. He looked upon the theory of evolution as being so grand and complete that he believed in it; and he thought future generations would be surprised to find that they had any difficulty in accepting the truth. Another obstacle was that the theory had somewhat offended their vanity. All of them were more or less ashamed of their poorer relations, and in this case they were particularly so. He did not believe that their immediate ancestors had tails, but they must not conceal from themselves that they all had tails, that is, rudimentary tails. Of course it was these rudimentary organs which were so convincing to the Evolutionist. The speaker pointed out that undeveloped people and idiots were remarkably like some animals of the monkey tribe. They went on all fours; they had not the gift of language; they were fond of imitation; were mischievous, tricky, and cunning; and were fond of climbing. All these were characteristics of the ape tribe. No doubt the whole of the monkey tribe would develop into something human and manly if they could only use the vocal organs which they possessed. There was no reason anatomically why a monkey should not speak. How at first the human voice became developed was a mystery. The explanation had been lost with other records of the past These lost records were a very great difficulty. They all spoke in a joking way about the missing link, and they could easily understand why there were these missing links. In the first place, only a small portion of the earth had been searched for geological records. They must remember, too, that bones and other human remains were very perishable, and when they expected to find

animal remains of thousands and thousands of years back, they were wanting something it would be difficult to get, for they had perished ages and ages ago. There had always been going on an immense struggle for existence, and the result of these struggles had been called the survival of the fittest. In this struggle the dominant race entirely exterminated the inferior race. He pointed out how the aborigines in Australia and America were being exterminated. In conclusion, the speaker said, for his part, he would rather be descended from an animal of the noble baboon-like character described by Darwin, than he would from some of the savages he (Dr. Fitzgerald) had mentioned that evening. (Laughter),

Mr. Walton said he would first of all like ask Mr. Ullyett how far he was prepared to go with the theory of development. He was aware that Darwin, in the closing passage of the "Origin of Species," told them that his theory would give grandeur to life, but on turning to later authorities, he found that they believed Darwin was then in error. The more recent teachers certainly did out-Darwin Darwin. They must remember that although Darwin did not touch on the origin of man in the Origin of Species, in a later publication he did. If they carried this theory to its legitimate conclusions, they could not exclude man from the argument. Then again, the very important point of the origin of life was bound up in the theory. How, it was, asked, did life come into existence? The speakers for Darwin answered, "By spontaneous generation." He wished to raise these points because they seemed to spring out of the theory as explained by Mr. Ullyett. It was perfectly true that Darwin did not claim that that they were directly descended from the apes. There were two branches from the Lemur—one going off to the right and terminating in man, and the other going off to the left and terminating in the ape. The speaker, in the course of further remarks, dwelt upon the fact that such an enormous length of time was required for the working out of this grand scheme. Writers upon it spoke of millions and millions of years, and certainly they could form no adequate idea of what might or might not take place in the course of such a length of time. It was certain that there were races which had a hairy covering to the body, and he was well aware of the fact that the examination of the brain of an ape side by side with that of a man would disclose extremely few differences in form. But there still seemed to be a wide gap between man and the ape. Man was possessed of the power of speech. When he consulted the Darwin authorities on this point he found that they asserted that language gave birth to reason. There was then a time when their ancestors had no reason because they had no language. Language in its origin was a mere meaningless articulation, but as their ancestors became

more and more able to give expression to their thoughts their reason developed. He felt bound to raise the points he had done, because he found that recent writers on zoology and botany distinctly took for granted the theory of spontaneous generation. The question—Can life be generated spontaneously or not? had been well sifted, and the most that could be said was that at present the theory rested upon no substantial basis whatever.

The Rev. J. Burgess asked Mr. Walton if he could find any single sentence in the writings of Darwin in favour of the theory of spontaneous generation. He (the speaker) believed that to be a doctrine which was not generally held by scientific men.

Mr. Walton said he was speaking of the men who out-Darwined Darwin.

Mr. Ullyett.—Most of the scientific men of the day are opposed to the theory of spontaneous generation.

Mr. Walton said he had not altogether been giving his own views on this matter, but he was merely stating the other side of the case.

The Chairman thought it had been proved that there was no truth in the theory of spontaneous generation; to him it seemed to be an impossibility and an absurdity, They must have a creative power; and spontaneous generation would mean the denial of a Creator.

The Rev. J. Burgess having quoted from the works of Darwin on the point,

Dr. Tyson made a few remarks. In the first place, he wished to disagree with part of what Mr. Ullyett had said. Now, they should be very careful to say what they meant by development; and what they meant by growth. Surely, development had taken place throughout all ages, and was taking place now. Growth to an organ meant an addition to some body or animal of the same material of which it consisted. Development was something *plus* growth; it meant something added by which the animal could do something he could not do before. If they accepted this definition, development had been going on and was still going on. And moral development must not be left out of the question If Darwinism had done nothing else it had brought out distinctly the advantage which accrued to man from recognising the importance of moral development. In dealing with the evolutionary theory of mankind, he took a distinct stand. He was going to support the so-called orthodox theory, because he did not believe in the extreme evolutionary ideas. There were one or two things he had put down which he thought could not be answered. Amongst the concessions of evolutionists the following were notorious. (1) That spontaneous generation must have occurred, or the doctrine of evolution, as held

by Huxley and his school, cannot be true. (2) That spontaneous generation has never been known to occur. (3) That it is against all the ascertained analogy of nature to suppose that it ever has occurred. (4) That if spontaneous generation has not occurred, it must be admitted that a supernatural act originated life in the primordial cell or cells. (5) That the true doctrine of evolution, as held by Huxley, cannot be true unless some bridge can be found to span the chasm between the living and the non-living. (6) That the present knowledge furnish us with no such bridge. Again, it was safe to say that evolutionists conceded that natural selection could not take leaps, and, therefore, a multitude of links must have existed between man and the highes apes; that after a diligent search of nearly forty years for traces of these missing links, none had been found; that in spite of the geological record, the destruction of these relics without traces is amazing, and that their absence leaves the argument for evolution weaker where it should be stronger; that the oldest human fossils exhibited in essential characteristics no approach to the ape type. The speaker then went on to say that Mr. Walton had mentioned that the brain of the ape was similar to the brain of a man, but there was an enormous difference between the two; the brain of the man being much the heaviest. He could also name a few other characteristics, which he was glad to say placed them at a great distance from the ape. In conclusion, Dr. Tyson said his opinion was that in the first stage a certain number of creatures were created, man being amongst the number, although he was in a lower state than he was at present, and that from these creations had sprung upwards and downwards all the animals that had existed or were existing.

The Rev. J. Burgess denied that Professor Huxley was a believer in spontaneous generation, and, in proof of this, quoted from an essay written in 1860.

Mr. Ullyett said he would be disposed to contradict all the points mentioned by Dr. Tyson.

The Chairman said he thought Dr. Tyson had put up a dummy for the purpose of knocking it down again.

Mr. Smurthwaite said he did not believe in the views propounded by Darwin. Referring to the quotation which had made from the "Origin of Species," about the theory giving a grandeur to life, he said that might be so; but after all, it was not science, and did not prove anything. The theological argument had been referred to, but he thought that should be allowed to remain in abeyance. As had been remarked, Darwin put his theory before them modestly and quietly, and he kept telling them, as if for fear they would embrace the idea, that was only a theory. He thought Professor Huxley said the theory was not proven.

Mr. Ullyett.—He calls it an established fact.

Mr. Smurthwaite, continuing, said he would willingly accept this theory if it could be proved, but at present there were no proofs. They spoke about mising links ; he wished they would supply some of them, and so let them have something tangible to consider.

Mr. Ullyett having pointed out some peculiarities to be found both in man and in the monkey,—

Dr. Eastes said he must assert that the advanced evolutionists of the present day did evolve all organised bodies from an inorganic substance which they called spontaneous generation ; and particularly Hackel, and others of the German school. They were all materialists, and he also believed Professor Huxley to be a materialist. What the Rev. J. Burgess had read to them, it should be remembered, was written 24 years ago, and the views of evolutionists had very much changed since then. He drew atttention to the fact that the doctrine was not proven, and said they need not, therefore, accept it as truth unless they chose.

The Rev. J. Burgess having offered a few remarks against the idea that the theory of spontaneous generation was generally held by scientists,

Mr. Ullyett replied. If they asked him what he thought about the theory, he said he did not wish them to go away with the idea that he believed in it or that he did not believe in it. His mind was about in the position of Mahommed's coffin when it hung between heaven and earth, and did not go either way.

The meeting shortly afterwards terminated.

Tuesday, January 20th, 1885.

A very large number of members were present to hear a lecture on Spectrum Analysis given by the Rev. J. Burgess, F.R.A.S. Dr. T. Eastes, Vice-President, took the chair.

SPECTRUM ANALYSIS.

The lecturer observed that he had hesitated as to whether he should better serve the interests of the Society by attempting a general exposition of the science of " Spectrum Analysis," or by using the available time in experimental illustrations, confining himself simply to such explanatory remarks as might be necessary to make the experiments intelligible. His decision had been taken in favour of the latter course; and for this reason chiefly,—that whereas any member of the Society whose studies had not been in

that direction, might, by the use of ordinary intelligence, and a little more than ordinary patience, acquire a knowledge of the facts and methods of this science, that truer and better knowledge which came from observation and experiment was not so readily accessible. Using therefore, such apparatus as he had at his disposal, he would endeavour to give at least some glimpses of this fascinating and important science. The first illustration was the famous and historical experiment of Newton. Using the oxy-hydrogen light as a substitute for the sun, the beautiful continuous spectrum of incandescent lime was produced by means of a carbon disulphide prism. The recomposition of white light was effected by the introduction of a second carbon disulphide prism put in a reversed position. The lecturer proceeded to answer two questions; first, what is light? Second, what is colour? The great advance made by Wollaston in 1802, by the use of a narrow slit parallel to the refracting edge of the prism, thereby securing a pure spectrum, was noted. The optical character of a prism was briefly described, and this was followed by a statement of Newton's discovery that the best effect of a prism is obtained when it is so placed that the ray under examination leaves the prism at exactly the same angle at which the incident ray falls upon it, the angle of minimum deviation. The spectrum was again thrown upon the screen, and a series of interesting experiments shown, illustrating the doctrine of colour. This was the more important, as colour was the special domain of spectrum analysis. The experiments included absorption, subjective colours, and complimentary colours. Dr. Wollaston, examining sunlight, as Newton had done more than a century before, found that the narrow slit he had introduced, enabled him to correct the observation of Newton, that the solar spectrum was continuous. Wollaston found, on the contrary, that it was divided or crossed by many narrow dark lines. This discovery was of the most vital importance. In 1814, Fraunhofer, a German optician, working quite independently, mapped out 576 of these lines in the solar spectrum, hence called Fraunhofer's lines, the more conspicuous and important being lettered A, B, C, &c. This discovery constituted a sort of foundation stone in modern spectrum analysis. The addition of a lens by Mr. Simms and Professor Swann, to the prism and slit, by which more light and better definition were obtained, was remarked upon. The construction of the modern spectroscope, for physical, chemical, and astronomical research, was briefly described, as was also a very large direct-vision spectroscope on the lecture table The lecturer next stated, and experimentally illustrated, some of the more important generalizations of the science of spectrum analysis. The fact that an incandescent body, either solid or liquid, gave a continuous spec-

trum was illustrated by the spectrum of incandescent lime. The fact that the spectrum of a glowing vapour had bright bands or lines, each vapour having its characteristic lines, was strikingly illustrated by an experiment with the optical lantern. A short Bunsen burner was suitably adjusted in the lantern—into its flame a pellet of sodium was introduced, on the screen at once appeared the yellow band so well known to spectroscopists as the sodium line, or lines, or the D line, or lines, in Fraunhofer's chart. The characteristic bright lines of lithium and strontium were shown to a few of the audience by means of the large direct vision spectroscope. Subsequently, using an induction coil and introducing into the electric circuit a Leyden phial, the spectra of lead and thallium were shown in the spectroscope. The lecturer proceeded to state and illustrate another principle of spectrum analysis. An incandescent solid or liquid body shining through absorbent vapours gave a continuous spectrum crossed by dark lines or hands these lines having in each instance the same position as the bright lines of the spectrum of the vapour,—given the same temperature and pressure In 1859 Kirchoff discovered that when the vapour of sodium was interposed between the slit and solar spectrum the D line was darkened. It was found that vapours absorb the same colours which they radiate or emit when heated to incandescence. This was the explanation of Fraunhofer's lines. When an incandescent body was surrounded by glowing vapours, one of three three things, the lecturer said, would happen; if the body and the vapour were at the same temperature there would be no result, as emission and absorption would be equal, if the temperature of the glowing vapour were higher than that of the body, the result would be bright lines, if lower, dark or absorption hands. By the introduction of a pellet of sodium about the size of a pea into the flame of a Bunsen burner in front of the slit the experiment known as the reversal of the sodium line was very successfully performed. The glowing sodium vapour at a lower temperature than the incandescent lime producing the spectrum on the screen, was crossed by a black absorption band. By the application of these principles, sodium, iron, hydrogen, and many other substances had been discovered in the sun. Screen projections of the spectra of various specimens of human blood in different conditions, and of the solar prominences were also exhibited. Spectrum analysis, the lecturer said, was the most subtle and far-reaching of all analytical methods. Other methods were refined and gave results of the greatest accuracy, but this transcended all others. Swan found that the lines of sodium are shown by the spectroscope when only one 2,500,000th of a grain of sodium was used. New metals, thallium indium, cæsium and rubidium had been discovered by the spectroscope. Since the

invention of the telescope no such instrument of research had been given to observational astronomy as the spectroscope. The light of sun, stars, nebulæ, comets had been analysed and by comparing these spectra with the known spectra of terrestrial objects knowlege was obtained of the physical condition and chemical constitution of bodies immeasurably distant.

A vote of thanks was warmly accorded on the motion of Dr. Eastes, in replying to which the lecturer kindly offered to arrange for an evening at his own house when those specially interested in the subject would be able individually to use the spectroscope.

It may be stated that a few evenings afterwards some of the members availed themselves of Mr. Burgess's kind invitation and spent a very pleasant hour among his instruments and specimens.

The above report is taken from the *Folkestone News*.

TUESDAY, APRIL 21ST, 1885.

The ANNUAL MEETING took place at the Town Hall, but the attendance was very small. The President was absent through illness, and the chair was taken by Dr. Bowles, Vice-President.

The chairman called upon the Secretary to read the Balance Sheet which showed that at the end of 1884 there was a small balance in hand of £1 6s. 11½d, but that since then an outstanding account for printing amounting to over eight pounds had been sent in, so that at the present time they were rather in arrear. The following report is taken from the *Folkestone Express*.

SECRETARY'S REPORT.

The annual meeting of the members of this society was held at the Town Hall on Tuesday evening, those present being Dr. Bowles, Dr. Tyson, the Rev. J Burgess, Messrs. Walton, Roberts, Knight, Nicholson, Hall, Smurthwaite, H. Ullyett, A. Ullyett, and several ladies. In the absence through indisposition of Dr. Fitzgerald, the President, Dr. Bowles, one of the Vice-Presidents, took the chair. The balance sheet to Christmas showed there was a balance in hand of £1 6s. 11½d. The secretary (Mr. Henry Ullyett). read his report as follows :—

"During the year 1884 seven meetings were held, all of which were well attended, and may be regarded on the whole as very successful. Papers have been read by the President on "Earthquakes and Volcanoes," and by the Secretary on "The Nautilus and Ammonite," and on "How to enjoy a Field Day," all of which

are to be found with others in the "Proceedings" of the last Session. Two Conversaziones have been held; one on March 11th, which was highly successful, both from the number of objects exhibited, and from the attendance; and one on October 21st, which was almost a failure, as only one or two sent any specimens. An admirable experimental lecture was given on April 8th, entitled "Electrical Discharge in high vacua," for which the society is deeply indebted to the Rev. J. Burgess.

"A successful Field Day was held at Lydden Spout on August 6th, when Mr. Walton, with his usual kindness and ability, conducted a botanical ramble. And on December 16th the proceedings took the form of a Discussion on Darwinism, concerning which there was so much to be said that the conclusion was postponed to a future meeting.

"As a society we may claim to be fairly prosperous, if not successful; we number at present 103 members, and like other prosperous societies, we are getting into debt. I acknowledge that our balance sheet made up last Christmas shows a sum of £1 6s. 11½d. in hand, but since then an account of long standing for printing has come in amounting to over eight pounds, none of which belongs to the present year. Out of our 103 members, 28 pay a subscription of 5s., the rest of half-a-crown. The committee would warmly appreciate the offer of any of the latter to enter the higher ranks. We are in correspondence with the following societies' with which we exchange copies of proceedings:—Academy of Natural Science, Philadelphia; Huddersfield Naturalists' Society; East Kent Natural History Society; Brighton and Sussex Natural History Society; Eastbourne Natural History Society. Copies of their papers are on the table.

"During the past year large and valuable additions have been made to the Museum which is still in our charge, and for these the town is indebted to the enlightened enterprise of our Town Council, which has for some time taken a real and solid interest in the collection. They look very favourably too on the proposition for securing a site in Rendezvous Street for new public buildings which, as Museum and School of Science and Art shall form a centre of education for the older youths of our borough. Not the least pleasing and satisfactory point in connection with this is the fact that 1300 ratepayers, representing all occupations and grades of society spontaneously sent a petition to the Council in favour of the project. One has had the pleasing dream recurring at intervals for some years, but there is I believe at last a prospect of its realisation.

"In conclusion, I have to give notice that at the meeting in May our indefatigable friend, Mr. Walton, will give us a paper on

" Mosses and Lichens." Also that we hope to have a Field Day in June, and shall be glad to receive any suggestions this evening as to the locality, and any offer as to the paper to be then read."

On the motion of Mr. Smurthwaite, seconded by Mr. Knight, the report was received and adopted.

Mr. Rev. J. Burgess moved that their best thanks be given to the honorary secretary. He said all naturalists' clubs where very largely indebted to their secretary, and that one above most clubs. His services had been so long and so able, that he was quite sure thay would not like to close the meeting or even to hear the President's address without thanking Mr. Ullyett.

Mr. Walton seconded the motion, which was unanimously carried.

Mr. Ullyett briefly acknowledged the compliment. He then said Dr. Fitzgerald had asked him to read the annual address, and to express his regret that he could not be present. Nothing but illness would have prevented him.

He then read the

PRESIDENT'S ADDRESS.

It is with no ordinary feelings that I had hoped to look around to-night at the members of the Society I have now so happily presided over for 17 years, and although I might miss perchance the faces of some old friends, I should see, nevertheless, others who have been constant from the first. Seventeen years! I feel much more like the father of you all than your formal President! and I venture to say if societies like ours did no other good than fostering feelings such as exist among us as naturalists, they would not be formed in vain.

But although friendly feelings, and even a moderate amount of mutual laudation, are all very well, they are not the end and aim of our Society; our object is to give and receive instruction. I wish I could congratulate you on a greater quantity of honest work done by members. There is, indeed, a small and ever willing body of working "bees," if I may so call them, all men too of scant leisure, who do all the work in the shape of reading papers, and to them our best thanks are due, but the rest, whom I am afraid I must call "drones," look placidly on but give no help! Yes, I know quite well what you will say. That you are so modest and humble you feel sure you could write nothing which would instruct or interest the society; but you are wrong. There are none among you, of either sex, who could not, by a little methodical expenditure of time and trouble, do work which would both interest and instruct us. It is only necessary to take some one subject and make it thoroughly your own. Do not attempt too much; select some

single branch of botany, geology, entomology, conchology, what you will, and work it honestly out in its every minutest detail, and you will soon find you will be able to give very valuable and interesting information. Take for example, some single grass, study its general and microscopical structure, its geographical distribution, the soil in which it flourishes best, its method of growth, flowering, seeding, microscopic appearance of its seed, often very beautiful, commercial value, &c., &c., or select, if you prefer it, some single flower, fern, or shell, but give it your undivided attention. Or keep some pet, such as a treefrog, spider, or tadpole, and observe closely its metamorphoses, diet, habits, and instincts, its likes and dislikes, character, and domestic life; or rear some particular butterfly or moth, such for example as the silkworm moth, watch carefully its wonderful metamorphoses, its different foods, its perceptions of light, sound, taste, and colour, its parasites and diseases, and then give the society the benefit of your researches. As an example of what I mean, I might cite Dewitz's exhaustive and most interesting treatise on "the construction and development of the sting of the Ant." This is the point I wish to impress on you, take one single subject, and "hammer away" at it, make yourself thoroughly familiar with it and there will no longer be any difficulty about your writing a paper. Again see what Huber, Forel, and more recently Sir John Lubbock, has done in his researches into the life history of Ants. What marvels they relate of their intelligence, their organised expeditions, their war-making, slave capturing, farming (if keeping milch animals and storing of forage can be so called), of their bridge building, architecture, burial processions, &c. I hope, ere long, to give you a paper on this subject, though, I, alas, have no time to practice what I preach, and must needs avail myself of the painstaking researches of others. I may instance also the immense interest and importance of the researches of Darwin, the most painstaking and indefatigable of investigators into the important, though unsuspected part played by that lowly animal the Earthworm in modifying, levelling, and fertilising the surface of the earth. How it not only acts as nature's plough, by bringing up to the surface the deeper particles of the soil, but also by so doing, spreads the germs of disease which were buried many a fathom deep, for I suppose you all know that those tiny twisted cylinders of earth, which are so numerous on grassy lands, are all "casts" of earth which have been swallowed and passed through the intestinal canal of the common Earthworm.

When we turn from our own little society, and attempt to review the advance of science during the last years, we find ourselves at one of the pauses or resting places of scientific progress. The origin and progress of science has always seemed to me like that of a

mighty river. Beginning in the remote past from small and and scarcely perceptible sources, it was augmented by here a streamlet, there a dewdrop, gathering strength and volume as it progressed in its course, and ever fed by fresh contributions. Sometimes flushed by a sudden and unforeseen influx, it has rushed madly on, perchance broken its bounds, overflowed its banks and devastated instead of fertilising its surroundings; at others fed gradually by constant supplies, it has flowed steadily and rapidly onwards, sweeping all opposition before it. Perhaps hindered by rocks or obstacles, its progress may have been delayed, yet still it has steadily advanced, impediments have been undermined, worn away, swept away. Then again the course has been less rapid, the stream has broadened and crept calmly on, making, perhaps, little perceptible progress, yet still slowly advancing and fertilising the banks on either side. Again there may be rapids, cataracts, dazzling by their power and brilliancy, but always progress, ever onward to the far ocean of Infinity—that Infinity which we, with our poor finite brains, can never hope to realise. We have now, after a series of brilliant and dazzling inventions, such as the Telephone, the Microphone, Phonograph, &c., which almost took away our breath by their rapid succession, arrived at one of those periods, such as I spoke of, when the river of science has spread out into a broad and placid stream, wider, far wider than ever, for it embraces an almost infinite variety in its bed, but its progress is, just now, slow and restful, and multitudinous as are the streamlets of experiment and observation which are pouring into it, there has of late been no wonderful or startling discovery. Perhaps we may be on the eve of some brilliant discovery which may sweep away half our present theories, and dazzle and bewilder us in the iridescent spray of novelty and wonder. Who can say? At present the oracle is silent. Even electric lighting, which awhile ago promised to revolutionise the present age, and literally to turn night into day, has made little apparent progress, and after an expenditure of between five and six millions sterling, spent on experiments, in little over two and half years, the present price of electric stock is something like one shilling in the pound. There are, nevertheless, patient toilers, working away silently and laboriously to solve the practical difficulties which alone prevent its universal adoption. Then again the phonograph, by which we hoped to preserve, record and reproduce the sounds and intonations imprinted on its revolving cylinder, has, as yet, proved scarcely more than a scientific toy, though it is true Dr. Zintgraff, of Bonn, has taken one with him to Central Africa to record the strange guttural sounds of the native dialects. Perhaps what may prove the greatest and most beneficial scientific work of the present age,

are the researches of Mons Pasteur into the life history of the special microbes or germs which produce those terrible and destructive diseases called charbon or anthrax, and rabies, or canine madness; the former of which costs agriculturists literally millions of pounds annually by its wholesale destruction of sheep, cattle, and horses, and the latter, as we all know, is even still more disastrous to the human race. A wonderful man is M. Pasteur! He began his chemical career as a mere assistant in a laboratory, and now it is not too much to say his discovery bids fair to revolutionise the whole science of medicine, and may possibly be the means of saving myriads of human lives, as it has even already preserved thousands of the lower animals. M. Pasteur first turned his attention to the different kinds of ferments, the germs which cause fermentation in wine, beer, &c., and proved that each kind had its own individuality, and could and should be cultivated separately, and made to produce only its own species of fermentation. This discovery was of immense commercial importance, for it practically led to certainty in place of uncertainty in the manufacture of these liquids. His next great work was the discovery of the Silkworm disease, called pebrine, which, since 1853, has been costing France some four millions of pounds annually, and which bid fair ere long to annihilate the silk trade of that country. Pasteur's researches led him not only to the indentification of the special bacillus which produced the disease, but also to the means necessary to detect and destroy it His next crusade was against that fatal disease called Anthrax or Charbon, or Splenic fever, which in severe cases often destroys the lives of sheep and horses in twenty-four hours. In one district of Russia alone, between the years 1867 and 1870, no less than 50,000 animals and 568 human beings perished of this fell disorder. Here, once more, he detected the special fungoid growth or bacillus, which produced such disastrous results, and found that by cultivating the germs out of the body, in broth for example (just as a gardener might raise seeds in a different soil) he was able to so weaken or modify their virulence that when used to vaccinate healthy animals they ensured perfect immunity from the disease without seriously affecting their health. Thus in a celebrated test experiment, which was watched with immense interest, not only by scientists but by practical men, Pasteur vaccinated 25 of a flock of 50 healthy sheep, and when they had recovered from the slight illness so produced, he publicly innoculated the whole flock with the virus of Charbon; the result was precisely what he had predicted, in 24 hours the 25 unprotected sheep were dead, while the 25 vaccinated animals were alive and well. But Pasteur's greatest achievement is his last, for although he has not yet indentified the special bacillus of Rabies he

has found that by cultivating and so weakening the virus or poison of this disease he can vaccinate dogs or other animals, and so protect them from all danger of hydrophobia. Thus out of 38 dogs, half of which were vaccinated and the other half not, that were bitten by 19 mad dogs, the unprotected animals all died of hydrophobia while the vaccinated speedly recovered. Whether we should any of us personally care to be so vaccinated on the chance of being some day bitten by a mad dog is a moot question, but all dogs exposed to this danger should be at any rate so protected. When we think not only of the thousands of lives that have been saved and the myriads which may be, but the vast field of speculation and enquiry opened up to the Scientist and Physician by the patient labour of one man, we cannot fail to be struck with the advantage of special study. This is a question which interests not only doctors but the world at large, for if animals can be protected by vaccination from Splenic fever, Fowl Cholera, and Rabies, may not mankind look forward to a time when they themselves may be made secure by similar means from all diseases, such as Diphtheria, Scarlet Fever, Croup, Cholera, Consumption, &c., which arise from germs? This then is one of the great problems of the day, and it seems in a fair way of being solved. But there is another problem which will also have to be solved, if not by this, certainly by the next generation, and that is the conservation of energy, the economy and utilisation of the enormous stores of now wasted power. For generations past we have been so in the habit of relying on the power generated by the combustion of coal, that we cannot, apparently, bring our minds to the contemplation of what is to be done when our coal measures are exhausted, which I need not say must happen sooner or later. Already we dig out from our English mines daily a mass of coal which if piled up would make a column 50ft. in diameter and 7,000 ft. high. I need not tell the merest child that this quantity cannot be abstracted each day without causing, at no very distant date, a serious diminution, and finally, an exhaustion of our stores, however large. What then are we to do when our stock is expended. I need remind no member of this society that heat, light, motion, and electricity, are all forms of one and the same force or energy, and that each is convertible into the other. Thus motion may be made to become heat, as we know from the heating of rapidly revolving axles, or when a cannon ball strikes an iron target producing heat, with or without a flash of light. A revolving electro-dynamo machine generates electricity, which may again be made to resolve itself into heat, motion, or light, and so on, in a never-ending cycle. But there must be always some form or other of force to start with. *Ex nihilo nihil fit.* Now it must have struck

most of us what an immense waste of unutilised force is for ever going on around us. Take for example, the rays of the sun, though of course, this applies more particularly to countries which are more abundantly blessed with sunshine than we are. If we could only economically (for that is the knotty problem—that question of £ s. d.) utilise the wasted light and heat of the sun by concave reflectors, condensers, convex lenses, &c., what an amount of work we might get from the mighty ruler of our universe. Then there is the power of the daily recurring tides, utilised at present only in floating ships up and down rivers—no small matter, by the way—but if we could only store up some, even a tithe of this immense energy, what work might we not accomplish with it. This is a scheme over which I have often pondered, but the only machinery I can in imagination devise, would be, I know, too intricate and ponderous to pay. What I believe to be the most feasible plan would be to collect and store up some of the prodigious water power running constantly to waste in the numberless rivers, torrents, and streams in different parts of the world. When travelling in Norway, Switzerland, the Tyrol, or other mountainous districts, I have often been struck with the almost limitless power thus running to waste from the innumerable torrents rushing down from the mountains above, and the comparative ease with which it might be made available and stored in Faure's or some other form of electric accumulators. This accumulator, I would remind you, is only a box 9in. high by 5in. in diameter, packed with a pair of lead plates coated with red lead. and sheathed in felt which is saturated with sulphuric acid and water. This is a simple and very portable machine and yet when charged with electricity from a battery, or revolving dynamos, is capable of receiving and storing up a charge of electric force or energy sufficient to lift one million pounds to the height of one foot. The cost of charging any number of boxes would be almost *nil*, for the motive power, which commonly necessitates a steam engine, *i.e.*, expensive coal and more expensive machinery, is here supplied by nature in infinite quantity and without cost. All that would be required, would be a revolving water wheel, which would, as it were, "tap" the power of the torrent and thereby turn dynamos, by which the electric force would be generated and stored in the accumulator. It would then become merely a question of expense of transport of the accumulators, and that is really "the rub," for these torrents and streams are usually in more or less inaccessible districts and the cost of carriage would be a very expensive item. Think of the motive power, the heating, the lighting power to be derived from Niagara; but the Americans, though an eminently practical people, are not quite educated up to this pitch.

To return to our own affairs we are all, I am sure, glad to welcome

a more liberal spirit in our Municipal Authorities, and a more thorough realisation of the uses and necessity of a proper building for a Museum and Art Classes. Hitherto the "powers that be" have seemed to consider that no place was too remote, gloomy, or inaccessible for a Museum, probably under the impression that the researches after science implied some difficulties and self-sacrifice; and anyone who has visited the gloomy premises where our museum is situated will acknowledge it requires both resolution and ingenuity to reach it. It appears, now however, that there really is a chance of our getting a museum in a conspicuous and accessible place, and one which will not be a disgrace to so rising and important a town as Folkestone. I trust, when we have obtained a more suitable locale, we shall strive to render our museum all that a provincial museum should be; not a place of mild amusement and recreation, a heterogeneous collection of South Sea Island bows, idols and mermaids, but an institution for popular instruction, calculated to diffuse scientific knowledge and cultivate a taste for natural history among the people For this purpose it should, as Mr. Gunther advised, consist of well assorted and well arranged specimens, representing as many types of living forms as are attainable; a series of economic products derived both from the animal and vegitable kingdoms; of useful as well as noxious and poisonous animals and plants, and last but not least, a complete and accurately named series of the flora and fauna of the neighbourhood. These are, I know well and gratefully acknowledge, the end and aim of Mr. Ullyett's indefatigable exertions, and right well has he endeavoured to carry them out; but a visit to our dismal cells in High Street will show you with what insuperable difficulties of want of light and space he has had to deal. I hope, however, we are on the eve of, literally, brighter days, and with this hope and a hearty wish for increased prosperity to our Folkestone Natural History Society, I will end these somewhat desultory remarks.

Dr. Bowles said they had heard the address, which he considered most excellent. It was a very difficult thing to write an address to generalise sufficiently well and yet to put the subjects clearly before them. Dr. Fitzgerald had succeeded admirably; he had touched on various points of natural history and science lightly and clearly so that they could all understand them and so as to excite in them a feeling that they would like to know more of the subjects. That of course was the end and aim of his address—to excite more thought on science and natural history—to excite in the minds of all a desire to help forward that society by doing something themselves to instruct others and to promote and advance science. He felt very greatly an amount of shame when Dr. Fitzgerald pointed out how little was done except by a few, and resolved

that if he had the time and the power to do it, he would certainly do something for the Folkestone Natural History Society, so that they would see at least Dr. Fitzgerald had done one thing—made one convert to the work, and he hoped there would be a great many more. He should ask them to accord Dr. Fitzgerald a vote of thanks, which was done.

ELECTION OF OFFICERS.

On the motion of Dr. Tyson, seconded by Mr. Hambridge, Dr Fitzgerald was re-elected president, Dr. Bowles, Dr. Tyson, and Dr. T. Eastes were elected vice-presidents, and the committee was composed as follows: The Mayor, the Rev. J. Burgess, the Rev. C. Bosanquet and Messrs. Walton, Scholey, Clark, and Smurthwaite. Mr. Ullyett was re-elected secretary.

A conversation ensued as to arrangements for future meetings, and the Secretary said five papers had been promised, and it was suggested that members of other societies in the county should be invited to read papers, in order that the monthly meetings might be held without interruption.

A vote of thanks to the chairman terminated the proceedings.

MAY 12TH, 1885.

At this meeting the following paper by Mr. G. C. Walton, F.L.S., L.D.S., was listened to with great interest. The diagrams and specimens were carefully examined by the members.

ON MOSSES.

Mosses or Musci belong to the great division of the vegetable kingdom called Cryptogamia or Acotyledones. With the Hepaticæ they constitute the group called Muscineæ. It will only be necessary for us to note the chief points of agreement and of difference between these two families. They are both made up of cellular tissue—that is to say, there is no vascular or woody tissue in them—and reproduction in both is effected by means of organs called Antheridia and Pistillidia. In both what is called alternation of generations is very clearly defined. On the other hand, Mosses have always a leafy stem—the leaves in two, three, or four rows, being usually arranged in a spiral manner—whereas in many Hepaticæ only a Lichen-like thallus is produced (as in Marchantia). When there are leaves they are arranged not round the stem as in Mosses but in two opposite rows each leaf overlapping another. Mosses have a spore-capsule—at first green and finally brown—

containing a columella, closed by an operculum (or lid) and covered by a calyptra (or veil), but in Hepaticœ the spores are produced in a blackish-coloured capsule which is without an operculum, and which opens to discharge the spores by valves, four to eight in number. Mosses have no elaters mixed with their spores, but plants of the order Hepaticœ have them and they are easily detected. They consist of two spiral fibres, which, so long as the spore case is entire, are closely coiled up but which, when free, stretch out like little corkscrews and aid in the dispersion of the spores. We must now turn Bryologists and give our attention to those most interesting plants which are the subject of this Evenings Paper. Abounding in stagnant water, and in damp heaths, and entering largely into the composition of peat are certain plants of a peculiar whitish or pinkish-white colour, and of such luxuriant growth as to form a beautiful soft carpet. These are sphagnums or Peat mosses of the order Sphagnaceœ. They take up a large quantity of water—which they retain a long time without rotting—and are able except when young, almost to do without their roots. In the splitting of their capsules, they resemble Andrœa a genus of mosses, and approach the Hepaticœ, but they differ from true mosses in their very peculiar leaf structure. The cells of the leaf are rhomboid or of irregular diamond shape, containing a spiral filament and appearing to be perforated here and there with holes. The Antheridia of Sphagnums being nearly spherical are unlike those of almost all other mosses while they resemble those of Hepaticœ. True mosses are called Urn-mosses because their capsule, with its separable lid, resembles an urn. And now, the way being so far clear, let us see what kind of plants we have to do with this evening. Let us ask first a few general questions and then go on to a closer examination of the various structures. What, then, *are* mosses? They are *cellular acrogens.* And what are cellular acrogens? Summit growers, made up, as already stated, entirely of that kind of tissue called cellular tissue. Mushrooms, lichens, and sea weeds are entirely cellular but are not summit growers—they are Thallogens. Ferns, Club-mosses, Pepperworts, and Horse-tails are summit growers but are not made up of cellular tissue only. On the contrary, they contain bundles of fibro-vascular tissue, and are called, on that account, *Vascular* Cryptogams. Have Mosses roots, stem, and leaves? Yes, these are usually well defined, so that our plants take higher rank than mushrooms, lichens, or seaweeds. What is to be said as to moss fructification? This consists of microscopic spores, contained in the capsules already mentioned. Do the spores grow and produce new plants? Not as a pea or bean does, but only indirectly. A pea or bean, the seed of a flowering plant, contains an embryo or rudimentary plant, but *a spore is*

a mere granule consisting of a single cell with a double membranous coat, containing no embryo, and, therefore, no plumule, radicle or cotyledons. Germination takes place from any part of it, and, in many cases, the body produced is not the future plant growing above ground but only a stage in the life-history of the plant —Moss or Fern as the case may be. When a *Fern* spore germinates it produces a flat leaf-like body called a prothallus, on which are formed antheridia and pistillidia, organs serving the same kind of purpose as the stamens and pistils of ordinary flowers. After fertilization has taken place, resulting in the production of a young fern, the prothallus, having served its purpose, withers away. When a *moss spore* germinates, a green mass of jointed threads called a *protonema* is produced, and from this there arise shoots that grow into moss plants, the protonema, except in a few cases, withering away (in the Ephermeræ, plants of rapid growth, the protonema is persistent during the life of the plant). It must be noticed that the fern spore gives rise not to the plant we call *a fern*, but to a prothallus which is called the *first generation* or sexual generation or oophore. The fern, as we see it above ground, does not bear antheridia and pistillidea but only spores. It is, therefore, called the *second generation*, the asexual generation or sporophore. Alternation of generations in mosses occurs in a different manner. First there is the spore, then the protonema, then the above-ground moss which is also the sexual generation or oophore. This generation, by means of its antheridia and pistillidia, brings about the asexual or second generation or sporophore which is none other than the *capsule*. Here, then, is the cycle of moss-life—spore, protonema, moss-plant, spore, over and over and over again. *Alternating generations*, are not confined to the Vegetable Kingdom but are very familiar to students of Zoology, for instance in the life-history of a jelly fish. The leaf of a moss which is always sessile, is a very important part of the plant, not only for obvious reasons but also because its structure has a great deal to do with *classification*. The field botanist remembers all about net-veined, parallel and forked venation, but does not need to know much about the details of leaf structure in order to refer a plant—say a Buttercup—to its natural order, but the student of mosses has, again and again, to use his magnifier (and his ' binocular ' too) in examining the *leaf* and trying to make out what is characteristic in its structure. The *areolation*, as it is called, is important in all mosses, but especially so in the case of those that never bears fruit. When examining such a moss, the student has to carefully note its habit and then look to the leaf to be his guide. It used to be thought that the *peristome* was, so to speak, everything, but now *the cell-structure of the leaf* is known to

be of equal or even of greater importance. The leaf has no stomata or breathing pores and consists generally of only one layer of cells, which are not all of the same size and shape, for those at the base are often much larger than those at the apex. Not only is the *size* of the cells noteworthy but also their *shape*, as this is found to be highly characteristic in whole families of Mosses. In many cases, the leaf is furnished with a vein, which is sometimes narrow and sometimes broad—in some cases it ends as a point to the leaf, while, in others, it is much prolonged into an excurrent point or hair, as in Tortula. In a rare case or two, it leaves the leaf much below the tip and so resembles the dorsal awn, so common in grasses Those bodies called stipules which are so noticeable in many families of flowering plants, do not occur in mosses, but they are found in many of the Hepaticœ. Chlorophyll, the green colouring matter of plants generally, is more or less abundant in mosses, in the protonema as well as in the leaves, the terms "highly chlorophyllose" and "sparingly chlorophyllose" being much used in descriptions. It is now time for us to look at one of these specimens (let us take the Polytrichum commune or common hair-moss) and ask what is that little vessel on the top of the stalk and what is the stalk itself? The vessel has been already spoken of as the capsule and the stalk is the *seta*, which lengthens with the development of the capsule or, strictly speaking, the sporogonium. The capsule and its contents are, collectively, *the fruit.* In our passage to a fuller description of this fruit, we must stop and see what provision is made for the reproductiou of mosses. We find no stamens and pistils, but we have male and female flowers by the co-operation of which reproduction is effected through the spore generation as already explained. Among flowering plants, the stamens and pistils are commonly enclosed in the same floral envelope but, in many cases, they are in different flowers on the same plant, and in other cases, on different plants. You will probably remember the terms hermaphrodite, monœcious, and diœcious, Mosses are hermaphrodite, monoicous, dioicous, or polyoicous, that is to say, the antheridia and pistillidia may be(1) on the same plant, or (2) on different plants, or (3) on the same as well as on different plants. In monoicous mosses, the different organs may be in the same inflorescence or in separate inflorescences on the same plants. The Antheridium (anther-like) is a sac, shaped very much like a club. It consists of a single coat and encloses a great number of tiny cells, which are filled with a kind of mucilage. Each cell contains an *antherozoid.* The Antheridium opens at the top to discharge its contents. The *antherozoid* is a slender threadlike body, which, being furnished at its thin end with two cilia, is able to move freely about. The Pistillidium is shaped very much like a Florence oil

flask. At the bottom of it is a single cell called the *Oosphere*, which, after contact with an Antherozoid, becomes the *sporogonium* and finally the capsule. But with some mosses in our hand where must we look for the Antheridia and Pistillidia? We must fix upon those clusters of leaves, often looking like buds, and examine them well. They vary in position and shape and different names (Perigone and Perigynium) have been given to them, according as they contain only one kind or both kinds of "flowers." The term "receptacle" is a convenient one. The leaves round the Antheridia are often brightly coloured. With the aid of our microscope we shall have a successful search, and shall notice surrounding the organs some jointed threads called *paraphyses*. Let us now trace the course of the capsule of a True Moss from its beginning and then see what it is like when mature. The oosphere grows thicker and thicker until it ruptures the case of the pistillidium near the bottom, leaving a part behind to form a vaginula (or sheath) for the seta, but carrying up the greater part to form the calyptra (or veil). (Free use was here made of diagrams and specimens). The oosphere has several coats which form the operculum and the peristome. Inside the growing oosphere the columella is formed, together with a large number of spores. Look, now, at the *complete capsule* (as seen in this excellent diagram). First comes the *veil* which can be easily lifted off, then the *lid*, which can also be removed, and then, in most mosses, comes the *peristome*. The peristome being thrown back, the columella and spores come into view. The veil and lid vary greatly in shape and size. They are often wanting in specimens we collect, simply because the spores could not be scattered were they to remain. The veil, on account of its shape, or of the way it is split or torn, is often a very valuable guide to the student, for instance in Encalypta (the extinguisher moss) the veil is large and conical. Let us suppose now that the veil and lid are gone. Now we see the mouth of the capsule either surrounded by a plain rim (Annulus) or by one or two rings (Orthotrichum, Bryum) of *teeth*. These are the *peristome* (round the mouth). Some mosses are gymnostomous (or naked mouthed) being without a peristome. The "teeth" may be four in number as in Georgia, or eight (Fissidens), or sixteen (Pottia, Ceratodon), or thirty-two (Tortula), or *sixty-four* (Polytrichum), the number being always *four or a multiple of four*. In Cryptogams, *four* seems to be characteristic just as five is in Exogens and three in Endogens. The teeth can be seen, and often counted without the use of a glass at all, though, of course, it is much better to have the assistance of the magnifier. No one who has never examined the mouth of a moss-capsule can have any true idea of the beauty that is there. The peristome is

often beautifully marked with transverse bars. It is highly hygrometric, but not equally so on both sides, so that the teeth close over the mouth of the capsule, when damp and spread out when dry. Their office, no doubt, is to aid in the dispersion of the spores and the provision made for this purpose is certainly remarkable. The teeth, in *some* genera are long, in others, short,—in some, obtuse, in others, acute,—in some, triangular, in others, lance-shaped,—in some, entire, in others, cleft,—in some, rigid, in others, frail,—in some, straight, in others, twisted—and so forth. Not a few genera take their names from some peculiarity in the peristomial teeth, for instance,—Dicranum (a fork), the 16 teeth being cleft so as to resemble forks. Ditrichum (two hairs), the 16 teeth, being cleft to the base into two thread-like portions—Brachydontium (short tooth) the teeth being quite short. Didymodon (twin tooth), the 16 teeth being cleft to the base into two nearly equal awl-shaped "legs"—Tortula (twisted), the teeth being long and (like the leaves of the plant when dry) strongly twisted, just as you would twist together a number of threads between your thumb and finger. Ceratodon (a horn tooth), the 16 cleft teeth resembling goat's horns. Dichodontium (to divide a tooth), the teeth being cleft to below the middle into two or three "legs." *All* genera, however, do not get their names from the form of the peristome, for example, Swartzia, is named after Schwartz; Blindia, after Blind; Georgia, after George III.; Catharinea, after Catherine II. of Russia; Pottia, after Pott; Buxbaumia, after Buxbaum; Seligeria, after Seliger. Again, "Polytrichum" (many hairs) has reference to the shaggy appearance of the Calyptra and "Atrichum" (no hairs), to the absence of hairs on the Calyptra. "Ephemerum" reminds us of the brief life of the species, and "Acaulon" (without a stem) tells us of stemless mosses. "Gymnostomum" (naked mouth), points to certain mosses that have no peristome. The *specific names* of mosses may refer to individuals or to some favourite habitat or some characteristic of growth, or to a dozen other things, for instance, we have Pottia Wilsoni, Georgia Brownii, Pottia lanceolata, Dicranum palustre, Barbula muralis, Ceratodon purpureus, and so forth. Let us return, for a minute, to the peristome, just to add a word as to its colour. This is of importance, as is also that of the seta. In each case it may range from quite a pale yellow to deep orange or purple. In the Polytrichums we cannot see the 32 or 64 teeth as they are underneath a membrane called an *epiphragm* This membrane, which seems to be a flattened top to the columella, is very characteristic of the genus. We must not stop for any further remarks on the spores but press on to note that few plants (if indeed any) *reproduce* themselves in so many ways as mosses. A single spore can, through the protonema, produce a large number

of plants. A portion of the protonema is changed into root-hairs (rhizoids) which produce a secondary protonema. The protonema can reproduce itself by *gemmæ* or buds. A protonema is produced on the leaves of many mosses, and even a *single* leaf, if separated from the plant and kept moist, may produce it. Again, portions of the growing plant such as shoots and bulbils, become detached to form new plants. Hairs, even, may be transformed into protenema. These facts certainly go to show that mosses are not very likely to follow the Megatherium and the Dodo. How are our plants arranged, or better perhaps, how do they arrange themselves for our convenience? There are four orders—Sphagnaceœ, Andreæaceœ, Phascaceœ and Bryaceæ. The first has already had about its share of our time. The second includes but a few small plants, some not a quarter of an inch high, all of which are classed by Bryologists with the True Mosses from which they differ in the splitting of the capsule. The third order (Phascaceœ) includes only a few genera, all the species (*e.g.* Ephemerum) being quite small plants. The spores escape through the decay of the capsule. The fourth and largest order, the Bryaceœ, or True Mosses, is very clearly marked by an operculum (already described) which is separated from the capsule, sometimes by the aid of an annulus. The True Mosses are divided into two sections. The *acrocarpi* (summit fruit), and the *Pleurocarpi* (side fruit),—the fruit, in the former, being at the top of the stem, while, in the latter, it is on lateral branches. Polytrichums, Tortulas, Bryums, and Funarias are all acrocarpous, and Hypnums are pleurocarpous. Very little attention was given to Mosses until about the beginning of last century, when the botanist Ray made a collection. About 1750 Dillenius published an illustrated work which is still of value and interest for reference, although of course it is very ancient considering the present date of our knowledge. In the time of Linnæus, and indeed by the great botanist himself, several of the allied orders of plants,—the Liverworts, the Club Mosses and Lichens for instance—were looked upon as Mosses, and we cannot be surprised at this when we remember that the microscope had not then made its wonderful revelations. The now familiar instrument threw a flood of light on many branches of natural science. To a distinguished German (Hedwig) belongs the honour of having discovered the foundation for a true system of Moss-classification. Of late years our knowledge has rapidly increased and many new species have been added to the list. Lastly, it cannot be claimed for Mosses that they are of any great use in every-day life, indeed, we make very little use of any of them—but they certainly have a beauty all their own. They decorate our old walls, fences, and trees as no human hand could, their "living green" contrasting splendidly, in our own

neighbourhood, with an abundant growth of quiet-coloured and rather washed-out looking lichens. One thing should be noted particularly by those who are disposed to pay attention to the Mosses, and that is that they may be studied all the year round. The usual fruiting time perhaps is the winter, but many species are a long time—several months—maturing their fruit. *Some* Mosses will have a *certain* soil, chalk or clay as the case may be, and many want a great deal of moisture, but some are not hard to please. Even "The bank whereon the wild Thyme grows" will be found to be a good place for the Bryologist, especially during wet weather and in the early months of the year. Many plants are *called* Mosses that are nothing of the kind. Two of such are used medicinally, namely Iceland "Moss," which is a Lichen, and Irish "Moss" which is a well-known seaweed, common enough on our own coast.

Folkestone Natural History Society

Established for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the summer one or two field excursions are taken.

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FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS.

EIGHTEENTH SESSION, 1885—1886.

October 13th, 1885.

The opening meeting was held in the Council Chamber, at the Town Hall. In spite of the heavy rain, the attendance was large. The following paper written for a Field Day, which had been prevented by bad weather, was read by the President, Dr. FitzGerald:—

ON ANTS.

There is perhaps no insect, I had almost said no animal, about which so much has been written, and so many diverse opinions held, as the Ant. While some authorities extol its intelligence and wonderful instinct, amounting almost to reason, others abuse it as being stupid, blundering, unequal to cope with the slightest difficulty, and unable to see beyond the end of its antennæ. I must confess that any casual observer who has watched the elaborate perverseness with which an average Ant endeavours to haul some, quite useless, object of double its size, nowhere, by the longest and most impracticable route, will be inclined to adopt this latter view. Now I do not mean to cite Mark Twain as being absolutely in the

first rank of scientific naturalists, but I must say, to my depraved taste, he is the most amusing, and this is what he says of Ants.

"It seems to me that in the matter of intellect the ant must be a strangely overrated bird. During many summers now I have watched him, when I ought to have been in better business, and I have not yet come across a living ant that seemed to have any more sense than a dead one. I refer to the ordinary ant, of course; I have had no experience of those wonderful Swiss and African ones which vote, keep drilled armies, hold slaves, and dispute about religion. Those particular ants may be all that the naturalist paints them, but I am persuaded that the average ant is a sham. I admit his industry, of course; he is the hardest-working creature in the world—when anybody is looking—but his leather-headedness is the point I make against him. He goes out foraging, he makes a capture, and then what does he do? Go home? No; he goes anywhere but home. He doesn't know where home is. His home may be only three feet away; no matter, he can't find it. He makes his capture, as I have said; it is generally something which can be of no sort of use to himself or anybody else; it is usually seven times bigger than it ought to be; he hunts out the awkwardest place to take hold of it; he lifts it bodily up in the air by main force, and starts—not towards home, but in the opposite direction; not calmly and wisely, but with a frantic haste which is wasteful of his strength; he fetches up against a pebble, and, instead of going around it, he climbs over it backwards, dragging his booty after him, tumbles down on the other side, jumps up in a passion, kicks the dust off his clothes, moistens his hands, grabs his property viciously, yanks it this way, then that, shoves it ahead of him a moment, turns tail, and lugs it after him another moment, gets madder and madder, then presently hoists it into the air and goes tearing away in an entirely new direction; comes to a weed; it never occurs to him to go aound it. No; he must climb it, and he does climb it, dragging his worthless property to the top—which is as bright a thing to do as it would be for me to carry a sack of flour from Heidelberg to Paris by way of Strasburg steeple, When he gets up there he finds that that is not the place; takes a cursory glance at the scenery, and either climbs down again or tumbles down, and starts off once more—as usual, in a new direction. At the end of half-an-hour he fetches up within six inches of the place he started from, and lays his burden down. Meantime, he has been over all the ground for two yards around, and climbed all the weeds and pebbles he came across. Now he wipes the sweat from his brow, strokes his limbs, and then marches aimlessly off, in as violent a hurry as ever. He traverses a good deal of zig-zag country, and by-and-by stumbles on his same booty again. He does not remem-

ber to have ever seen it before; he looks around to see which is not the way home, grabs his bundle, and starts. He goes through the same adventures he had before; finally stops to rest, and a friend comes along. Evidently the friend remembers that a last year's grasshopper leg is a very noble acquisition, and enquires where he got it. Evidently the proprietor does not remember exactly where he did get it, but thinks he got it around here somewhere. Evidently the friend contracts to help him freight it home. Then, with a judgment peculiarly antic (pun not intentional) they take hold of opposite ends of that grasshopper's leg and begin to tug with all their might in opposite directions. Presently they take a rest, and confer together. They decide that something is wrong, they can't make out what. Then they go at it again, just as before. Same result. Mutual recriminations follow. Evidently each accuses the other of being an obstructionist. They warm up, and the dispute ends in a fight. They lock themselves together, and chaw each other's jaws for a while; then they roll and tumble on the ground till one loses a horn or a leg and has to haul off for repairs. They make up and go to work again in the same old insane way, but the crippled ant is at a disadvantage; tug as he may, the other one drags off the booty and him at the end of it. Instead of giving up, he hangs on, and gets his skin bruised against every obstruction that comes in the way. By-and-by, when that grasshopper leg has been dragged all over the same old ground once more, it is finally dumped about the spot where it originally lay. The two perspiring ants inspect it thoughtfully, and decide that dried grasshopper legs are a poor sort of property after all, and then each starts off in a different direction to see if he can't find an old nail or something else that is heavy enough to afford entertainment and at the same time valueless enough to make an ant want to own it. Science has recently discovered that the ant does not lay up anything for winter use. This will knock him out of literature to some extent. He does not work, except when people are looking, and only then when the observer has a green, naturalistic look, and seems to be taking notes. This amounts to deception, and will injure him for the Sunday schools. He has not judgment enough to know what is good to eat from what isn't. This amounts to ignorance, and will impair the world's respect for him. He cannot stroll around a stump and find his way home again. This amounty to idiocy, and once the damaging fact is established, thoughtful people will cease to look up to him, the sentimental will cease to fondle him. His vaunted industry is but a vanity and of no effect, since he never gets home with anything he starts with. This disposes of the last remnant of his reputation, and wholly destroys his main usefulness as a moral agent,since it will make the sluggard hesitate to go to

him any more. It is strange beyond comprehension that so manifest a humbug as the ant has been able to fool so many nations, and keep it up so many ages without being found out."

There is no doubt considerable truth in this humourous description, and individual ants certainly are sometimes, according to Sir John Lubbock's observations, singularly stupid in finding their way home; they nevertheless in their collective social capacity exhibit wonderful intelligence. Ants, as most of you know, belong to the Hymenopterous insects, that is to say, the same class as bees, wasps, and hornets, and possess, like them, four membranous wings, the lady members alone possess a sting. They have also a much larger jaw than the males. There are three descriptions of ants, males, females, and neuters; these latter are really undeveloped females, and do all the hard work of the community, they fetch and carry, tend the young, provide food, and even do all the fighting; it would almost seem as though these little creatures had succeeded better than their sisters of a higher organization, and had actually attained to "Women's Rights." Ants undergo a regular metamorphosis, from larva or grub, to pupa or chrysalis, whence they emerge as perfect insects. The males and females are provided with wings, though when they become steady married people, with a family to support, the ladies very judiciously lay aside their wings, and decide to soar no more; the spinster ants (no fun is intended) are not provided with wings. Every one has noticed the little wingless ants rushing about with small oval white bodies in their mouths; these are the so-called "ant's eggs," so dear to the young canary and nightingale, they are really not eggs at all, but the larvæ or grub of the ant, and more nearly resembling babies than eggs; they are carefully tended and fed by the neuters, who press the food out of their own mouths into theirs, and on fine days these careful nurses carry their charges out into the air and sunshine, but hasten with them indoors if it becomes cold or wet. Sir John Lubbock says they carefully sort them according to age and size. When the mature ants emerge from their cocoons these same indefatigable workers are at hand to assist them out of their envelopes and wraps, to unfold their legs and smooth out their wings, and otherwise assist at their first toilet; indeed many of their interesting young charges would die were it not for this assistance. Then when the impeding wrappers are finally removed, they are piled, with real spinster precision, in a heap outside the nest. There exists considerable misapprehension as to the length of time ants live, and their existence has been usually thought to be a very short one. Sir John Lubbock has, however, had ants which have been his pensioners for eight or ten years. His device for recognizing individuals is ingenious, he regales them with a dainty feast of honey, to

which ants are particularly partial, and then when they are intent on sensual enjoyment he surreptitiously puts a small distinctive dab of paint on their backs. We have heard a great deal of slave making and marauding ants, and that they do nefariously and violently carry off, appropriate, and annex the offspring, *i.e*, the larvæ of their neighbours, there can be no doubt, but the careful observations of Sir John Lubbock give quite a different aspect and character to acts which might be otherwise thought derogatory to the character of an honourable ant. We all know that the whole end and aim of an ant's life is, apparently, to carry something about in its mouth; it may be something useful, or it may not, but something it must be; it is apparently the same instinct which compels the female of our own species even to have something in her hand, it may be a piece of work, or a baby, or it may be a fan, a parasol, or even, in extreme cases, a walking stick. Well, it is the same with what I may call, without disrespect, the spinster ant; thus, if in their wanderings they come across the nest of other ants and find a number of larvæ lying around, they immediately seize on them and carry them off, and resist any attempt to recapture them to the death, as a disgraceful interference with the "rights of the subject." Having got their prizes safely home, they rear them with the greatest care and tenderness, feed and air them as though they were their very own. It is true that when their captives attain to "ant's estate" they work them pretty hard, but then it is not in ant's (or man's) nature to give anything for nothing. If an ant cannot find any larvæ knocking about, it will pick up small seeds, bits of stick, the hind leg of a beetle, or any little treasure of that kind, though no doubt it finds the soft succulent body of a tender young larvæ pleasanter to its jaws. It is in this way they carry off the eggs of the aphis, or green fly, which infests greenhouses, and is the horror of every gardener. These eggs they carefully tend and rear till they become juvenile aphids, which they keep for milking purposes. Ants are extremely fond of sweets of all kinds, and it happens that aphids secrete a clear sweet honey-like fluid which distils from two little prominences on their bodies. When the ant wishes for a little refreshment, it strikes these prominences gently with its antennæ, first on one side and then on the other, and the sweet fluid exudes in the appreciative jaws of the master; the aphids seem to submit quite willingly and quietly to the process. They occasionally make use of their gentle captives for less agreeable purposes. Herr Volkbaum, for example, observed some ants on a maple tree which had been tarred round the bottom; wishing to cross over the tarry position, they brought a number of aphids down from the tree, and stuck their bodies ruthlessly, in the tar, so as to form a causeway over which they might pass without soiling their dainty

feet. There is, in ant communities, a regular division of labour, some are foragers only, and provide food, others nurse and feed the larvæ and carry them about, some which are armed with strong biting jaws, or mandibles, are the soldiers and do all the fighting, others again are solely engaged in capturing slaves. It is an instructive exemplification of the demoralizing influence of slavery to observe the complete extinction of all the nobler qualities, and the abject state of dependence on their slaves exhibited by the slave-making ants. The most notable example of this state of things is furnished by the Polyergus Rufescens, a large reddish brown ant, which is entirely dependent on the services of its captured slaves, indeed without their ministrations, they would die of starvation, even though surrounded by plenty. They are fed, cleaned, and carried about by their devoted attendants; under this demoralizing treatment they have gradually degenerated, and have lost their natural and nobler instincts, they no longer care for their offspring, have lost the power of building, are indifferent to friends or strangers, and are quite unable to forage for food, or even to eat it unless it is actually put in their mouths by their slaves; even their bodily structures have deteriorated, the mandibles have lost their teeth, and are mere nippers and useless except for fighting purposes, though they are then formidable weapons. The method of fighting is peculiar but effective; if sufficiently provoked, by a strange ant biting its leg, for example, it will jump on its back, and either make its powerful and pointed mandibles meet in its adversary's brain, or seizing it by the root of the neck will deliberately saw its enemy's head off, in which case its adversary usually lets go its hold, but by no means necessarily, for a bull dog is a mere trifler in tenacity, compared with an ant Once having closed their jaws not even death will unclose them, it is literally a case of lock-jaw, and an ant may frequently be seen walking about with the head of an enemy firmly fixed on to one of its legs. This curious tenacity M. Mocquery tells us, is utilized by the South American Indians, who hold the edges of a wound close together, and then get an ant to bite through the two lips, after which they snip off its head. M. Mocquery says he has seen natives with wounds thus held together by as many as eight or ten ants' heads. It is a moot point how far ants are actuated by feelings of friendship. I mean of course for members of their own nest, for every stranger is necessarily an enemy, and as such to be driven away or killed. They adopt tne Lancashire doctrine, 'con amore,' and if they see a stranger they invariably "heave arf a brick at him." Many observers have tried to solve the problem by smearing ants with treacle, drowning them in water, burying them under earth or stones, and such like playful devices, and seeing if they were rescued by friends. Mr. Romanes

says they *are*, and he has seen an ant helped out from under a stone by the united efforts of its friends, who pulled it out by hauling at its legs, and he has watched a disconsolate mourning ant unearth the recently interred body of a deceased relative; but there seems some little doubt whether that was not for the purpose of eating him. Sir John Lubbock, intoxicated a number of ants with spirits, and found their friends from the same nest generally carried off their insensible relatives, but threw all strangers into a little ditch of water. They also treated a few friendly ants to a cold douch, but eventually rescued them on discovering their mistake, but whether this was done on "blue ribbon" principles as a punishment, or not, we are unable to say. Ants dipped in water were nsually quite neglected; those immersed in treacle or honey were invariably licked dry; now this is suspicious, and places our ant's principles in a painfully doubtful light. On the whole Sir John comes to the conclusion that the emotion of dislike is certainly stronger than that of friendship in the ant, for while any average ant is always certain to attack a stranger, he is by no means so sure to assist a friend, unless indeed there is something to be got out of him. The principal food of the ants is insects, of which they consume large quantities; indeed, Forel, when he was observing a slave nest, found that 28 dead insects per minute were brought in, which amounts to 100,000 insects a day, destroyed by this one nest. Darwin says this is one agency by which plants are protected from insects, which would otherwise infest them and consume their juices. When we consider the countless millions of ants which exist, we can form some idea of the myriads of insects thus destroyed. Ants, too, are very fond of honey and honey dew, or any sweet substance, and Darwin, with his usual acuteness, has pointed out the various expedients by which plants are protected from their ravages which would otherwise leave but little honey for the bees. Sir John alludes to several of these obstacles, such as inverted hairs on the footstalks of plants, viscid and acrid secretions, downturned and slippery flowers, &c.; while water plants, which do not need the same protection, are destitute of such aids. There has been much controversy as to whether ants store up grain for winter use. It is almost certain no English ants do so; but careful foreign observers have seen ants harvesting rice and other grain; now as they cannot masticate any hard substance, it is supposed they keep the grain until it germinates, and then suck the sweet juices produced by the natural conversion of starch into sugar which takes place at that time. They even check any super-abundant germination by nipping off the points of the young shoots. Apropos of food, it is a curious fact that the same eggs can be caused to develope into either males, females, or neuters, according to the kind of food supplied to the larvæ or grubs. As to the intelli-

gence of ants there is a great diversity of evidence, and it would almost appear as though they were a mixture of the highest intelligence and the most crass stupidity. Some observers have seen them carry pieces of straw, and bridge over an otherwise impassable gulf, and even prepare a buttress on the opposite side, tilt a straw over to it, and firmly cement both ends with a mortar composed of earth and saliva. Sir John Lubbock on the other hand says that in all his experiments they failed to circumvent the most trifling obstacles, even when they could have easily overcome them by moving a few grains of earth, or shifting the position of a piece of straw, or small stick. Instead of which they laboriously wandered off by the most roundabout paths, while the much loved honey, or larvæ, were within a few inches of their noses. It seems certain that in spite of their compound eye with its 1200 facets, ants possess very limited powers of vision, restricted apparently, to the perception of light, by which they seem to guide their movements. Indeed, as Sir John Lubbock quaintly remarks, if each of the 1200 eyes gave, as with us a separate image, it would lead to very awkward results both in love and war, for it would be equally embarrassing for an unfortunate ant to see before him 1200 wives from whom to select, or 1200 enemies to combat with. In spite of its apparent complexity, the eye of the ant is of a very rudimentary character, and the antennæ play a far more important part in influencing its actions. The brain of the ant is represented by a small spec or knob of nervous matter, it is not of the relatively large size it is often represented to be, and it is essentially what may be called an "antennal" brain, for the antennæ represent all the special senses; by the antennæ does the little insect recognize friend from foe; whether by their agency it can perceive sounds is doubtful, it certainly cannot hear any sound which is audible to human ears, though it is quite possible it may be conscious of sounds which are too acute for us to hear. The antennæ are able to discriminate different odours, and are probably thus useful in selecting food. They are indeed the all important organs of ant life, whether used to recognize or caress, or shampoo a friend, to milk an aphid, or to cross with those of an enemy before attack, as two fencers cross their foils previous to engaging. The ants of Texas are said to have regular cemeteries, and bury their dead in them with well marked ceremony; indeed Mr. Romanes cites instances where the black slave ants were interred in separate cemeteries to their masters. Mrs. Hutton gives a most interesting account of some funeral obsequies she witnessed in Sydney. Having killed a number of soldier ants she returned in half an hour to the spot, and saw a large number of ants surround- the dead ones. Four or five started off towards a hillock a short distance off in which was an ants' nest. This they entered, and in

about five minutes they reappeared, followed by others. All fell into rank, walking regularly and slowly two by two, until they arrived at the spot where lay the dead bodies of the soldier ants. In a few minutes two of the ants advanced and took up the dead body of one of their comrades, then two others, and so on, until all were ready to march. First walked two ants bearing a body, then two without a burden; then two others with another dead ant, and so on until the line extended to about forty pairs, and the procession now moved slowly onwards followed by an irregular body of about 200 ants. Occasionally the two laden ants stopped, and laying down the dead ant it was taken up by the two walking unburdened behind them, and thus, by occasionally relieving each other, they arrived at a sandy spot near the sea. The body of ants now commenced digging, with their jaws, a number of holes in the ground, into each of which a dead ant was laid, where they now laboured on until they had filled up the ants' graves. This did not quite finish the remarkable circumstances attending these obsequies. Some six or seven of the ants had meanly attempted to run off without performing their share of the task of digging, these were caught and brought back, when they were attacked by the whole body of the ants and killed upon the spot. A single grave was then roughly dug for the whole of the malefactors and they were indiscriminately dropped into it. You observe the brave warriors were respectfully deposited in separate graves, while the guilty ants were promptly executed and thrown into one common unhallowed grave! Ants have been seen to bridge over a small rill by pushing a thin twig across it, and when this was found too narrow for the transit of the main body, a number of ants ran along the edges of the twig and adhered to the sides, until it was sufficiently broad for the main body to cross conveniently. On another occasion when passing over a bank of crumbling sand which afforded no stable footing, a number of them adhered together and formed a firm gangway for their companions to pass over. Such acts as these argue a degree of instinct which may almost be called reason. And yet on the other hand we have Sir John Lubbock's careful and repeated experiments, in which he invariably found that if he moved the coveted store of honey or larvæ even a couple of inches from its previous position, the ants were quite unable to find it, and wandered aimlessly about for hours, until they stumbled upon it at last quite accidentally. He took the trouble to trace out some of these devious wanderings with the sharp point of a lead pencil, and the resulting diagrams are confused mazes of intersecting lines, meandering about without end or aim. With all this conflicting evidence before us, I think the only conclusion we can come to is, that placed in certain definite and natural circumstances, the inherited and trans-

mitted instinct of the ant comes into play and is of so high an order, that it enables them to perform certain automatic and concerted actions of a very elaborate character, but that when these conditions are interferred with or reversed, the intelligence of the individual ant is not fitted to cope with them.

NOVEMBER 10th, 1885,

The meeting was held in the Committee Room at the Town Hall. The attendance was very large, Dr. FitzGerald took the chair, and called upon the Secretary to read the following paper on

"A FLINT STONE."

It is a very ordinary object, common almost everywhere, at least in this part of England. They lie in accumulated heaps along the road side, they are scattered by thousands in the thin soil of our cultivated hill tops. So common, and so ordinary, and to the casual observer so unattractive, that one can hardly be expected to make them "things of beauty." Yet I hope to show you that great interest attaches to them, that they present knotty problems to the geologist, that uulikely as it may seem at first sight, they are closely connected with life, both animal and vegetable, and that some at least of the highly prized gems that we wear owe their origin to them, or have a common origin with them; and most of this information can be extracted from the flint stones themselves. For it is true, as more than one writer has said, that every pebble by the road side contains its own history, compressed in its own substance, and it is our imperfection when we cannot read that history and that origin aright.

I have put before you as specimens one or two of the commonest flint stones, in no way different or superior to their fellows. If it had been possible I would have put on the table one that would certainly have attracted all your attention—a monster from among his kind. Those of our members who have been with us to Lydden Spout will probably remember the two gigantic flints standing before the old man's cottage. One of these was nearly a yard across, and I day say weighed a couple of hundred weights. It would have formed a worthy visible text for a lecture, but as you may guess, there were difficulties of transport in the way, and questions of the resisting power of our table would arise, so that we can only make a reference to it.

But these smaller scattered specimens that we find in every field-we cannot help asking how came they there, and when? In the face of the cliffs reaching from Dover onward we may find an answer to the latter question. There we see them in long, unending, parallel lines, one above the other at varying intervals, stretching away into the distance; all who have lived in, or visited chalk districts have learned to associate chalk and flint. Yet it would be incorrect to assume that flint is limited to that rock; it is found in many others though far more sparingly. But undoubtedly all the flints in Kent and the adjoining counties have once belonged to beds of chalk. In the fields they greatly annoy the farmer; in spite of all his diligence in periodically clearing the ground of them, they seem to be as numerous as ever, giving some apparent ground for the belief prevalent in some parts of England that they grow there and we cannot extirpate them. When we ask how they came among the soil of our fields the geologist tells us they were left behind when the chalk beds wasted away, for it is part of their creed—and a credible part of it in all senses, that beds of chalk once stretched all over the Weald of Kent, but that the rain, rivers, and frost of long ages have washed it back to our present line of hills. The flints, being of more unyielding material, remained behind as permanent witnesses of the great change,

And there are puzzling questions too about these long flint lines in the cliff. By what strange natural laws and processes came they there? For we know that these lines are but the edges of vast sheets of flints underlying the chalk and covering probably an area of many square miles. Beds of sand, we can readily understand, were deposited in the waters; the white chalk consists we are told of microscopic shells which gradually subsided to the bottom of the ocean as the occupants died, and there accumulated age after age: but flint in its multiplied forms, strange and often grotesque—how came it to alternate with this spotless limestone, not being limestone itself? Is it also organic? Or is it a sediment? If the latter how came it in such uncouth shapes?

And yet perhaps, when we come to examine it, not altogether so uncouth; we have some shapely forms before us, and a very little consideration inclines us to the belief in an organic origin. Undoubtedly some of those specimens on the table are petrified sponges, shells, and other animal formations.

Now, if we appeal to the chemist for aid in our study of flint, we are told at once in learned language that it consists almost wholly of "silica," which is a combination of oxygen with the element *silicon*. This silica in a thousand forms enters very largely into the composition of the earth's crust; there are few rocks which do not contain it. In combination with water it forms silicic acid

from which are produced rocks called *silicates.* The purest form of this silica is known as *Rock-crystal*, from the clear varieties of which our "pebble" spectacles are made. In its own natural state of purity it is crystalline *quartz*—a beautiful six-sided prism terminated at each end by a pyramid, or more commonly there is a pyramid at one end, the crystal being attached by the other end to some rock. Some very small perfect double-ended specimens are in a box on the table, and are best seen with the hand magnifier. They are sifted out from earth in the neighbourhood of Buxton, and are sold as "Buxton diamonds." Other specimens of various sizes are before you. The largest I ever saw was at Chatsworth; it stands on the floor of the statuary room, and is over three feet high.

Many specimens of quartz are sufficiently hard to cut glass; in fact it is only exceeded in hardness by the topaz, sapphire, and diamond. It was the substance which first received the name "crystal" from the Greek *crystallos*—ice, from the idea that it was water so far congealed that it could never be restored to the liquid condition. In an opaque amorphous form it is a very common substance on our older mountains, *e.g.*, in Wales and the Highlands.

When this silica is coloured by the presence of organic matter, iron, &c., we get the "stones" known as amethyst, cairngorm, chalcedony, carnelian, jasper, agate, onyx, opal, and others. Opal often replaces the original matter in petrified wood. It is largely deposited by boiling springs and is called *sinter*. Most natural waters of all temperatures contain some silica, of which the diatoms make their cases. It is probably obtained by the disintegration of various rock silicates, and so finds its way into both water and the soil.

The Agate is perhaps the best known of the stones we have mentioned, and certainly, so far as variety is regarded, it is one of the most beautiful. It seems to be silica deposited from water by successive coatings round some nucleus. The "Moss Agate" owes its appearance to what are called dendritic markings, *i.e.* markings resembling a miniature tree. They are mineral markings and not fossil remains. Chalcedony occurs not uncommonly in flints; in its purest form it is milk white with a bluish tint; more frequently it is red or brown, and from the best varieties of this colour carnelians are made. When banded it passes into the Agate.

The whiter varieties of sand are nearly pure silica. The dark colour of our flint stones is owing, as we shall presently see to organic or carbonaceous matter, and is destroyed by heat, the flint then becoming white.

So far we have spoken of flint or silica only in connection with the mineral world.

That it has, as I said, a close connection with living things, animal

and vegetable, is readily proved. The polished appearance of a stem of wheat is owing to silica; the leaf blades of some of the coarser grasses are so highly charged with it that they draw blood when passed rapidly between the fingers; the *Equisetæ* or horse-tails contain so much that a polishing powder is made from their ashes; the leaf hairs of some plants are wholly siliceous; while from the interior of one of the bamboos of India large lumps are sometimes taken in the form of Tabasheer, a more highly refracting substance than even the diamond. Of course all this is extracted by the plant from the soil.

In the animal creation its abundance is more remarkable still. Countless species of the microscopic forms known as diatoms construct their exquisitely beautiful shells from the silica yielded by the waters in which they live. You can examine some of these for yourselves in the microscopes on the table. Enormous areas of the bed of the Pacific were found by the Challenger to be covered with siliceous, *i.e.*, flinty deposits, consisting chiefly of Radiolaria. Some were brought up by the dredge from a depth of five miles. Mingled with them were the "spicules" of sponges. These are minute needle shaped bodies composed of silica, supporting the soft framework of animal matter forming the sponge. Thus silently, and hidden from the eye of man, the processes of nature are carried on in almost abysmal depths, laying the foundations of future worlds and writing in indelible characters the history of their own times. Other sponges anchor themselves to the mud or rocks of the ocean bed by ropes of siliceous fibres, rising up by a single long chimney-like tube. See the *Euplectella* before you.—Venus' Flower Basket, "without any exception one of the most exquisite of all organic structures known to us." In its living condition this skeleton, which is wholly silica, is completely covered by a thick coating of animal matter called by zoologists *sarcode*. Another family includes the *Hyalonema* or glass-rope sponge, which "has the lower portion of its siliceous rope-like axis exactly like a skein of threads of glass, and is sunk in the sand at the bottom of the sea." This is a rarer form judging by the price asked for it at present (two pounds), but you will find an illustration of it, and also of its beautiful spicules, in the volume of Science Gossip on the table. (Vol. for 1872, p. 36)

Now, remembering all this, and then noticing the very frequent occurrence of sponges and their spicules, shells, and other animal remains in flint, we are led to make a shrewd guess that life in some form or other had to do with its formation. A very large proportion of those flints of curious shape on every wayside heap—semi-globular, spherical, cup-like, branched, &c., will be found to have fossil remains inside. Frequently a dexterous blow of the hammer separates the flint symmetrically, and numbers of spicules,

some large enough to be seen with the naked eye, fall out loosely from the interior. There can be no doubt of the sponge origin of such flints. Then, though we regard flint as one of the hardest substances we have, look at those specimens before you in which you get a perfect model of a whole shell, or in which you find a fossil shell, itself silicified, partly in, and partly out of the solid flint. It did not get in there after the flint was formed, it was there first, and the silica must have settled round it. And even the darkest, densest parts of flint show in microscopic sections numerous organisms, notably *xanthidia*—round minute bodies studded with rays, which are believed to be gemmules, the immature forms of sponges. What does all this point to? Let us see what light has been thrown upon flint formation by those who have carefully examined and studied the subject. "Constant association of flints with traces more or less marked of former abundant siliceous organisms seems to make the inference irresistible that the substance of the flint has been derived from these organisms. The silica has first been abstracted from sea water by living organisms. It has then been re-dissolved and re-deposited (probably through the agency of decomposing organic matter), sometimes in amorphous concretions, sometimes replacing the calcareous parts of echini, molluscs,&c., while the surrounding matrix was doubtless still a soft watery ooze under the sea." (Geikie.)

Taking this compressed account, let me endeavour to explain and illustrate it. We have already seen that certain creatures in the sea have the power of secreting silica from the waters to form some kind of framework or protection for their soft, gelatinous bodies. No doubt the case of the coral polyp occurs to you, extracting carbonate of lime from the waters, and we might too hastily jump to the conclusion that flint was formed in a similar way to coral. But it can hardly be so. Whatever power the creature may possess during life to extract silica from the waters for the formation of a skeleton, say like that of the Euplectella, for a chastely ornamented shell like that of a diatom, or for spicules like those found in some sponges, it would not wholly envelope itself in the substance, since that must needs hasten its own destruction. The flint was formed after the death of the creature whose remains are enclosed in it. In fact its deposition was a chemical operation.

One of the ultimate elements of organic matter, vegetable or animal, is carbon, and the bodies of all creatures give off after death a quantity of carbonic acid. Now there is a very close chemical relation between carbon and *silicon*, the element out of which silica is formed. Both come into the same natural group of elements, both form similar series of compounds with other elements. And we generally find in such cases that to a certain

extent the two elements are interchangeable; one can take the place of the other in a compound. Is it not probable then that the carbonic acid given off by the decaying body of a sponge or other animal, may change places with the silicic acid which is in combination with other substances in the water, and that where we had a silicate of soda or potash in the latter we now get a carbonate, while silica from the silicic acid deposits itself on the remaining organic matter in its place? The operation must have gone on gradually and under very favourable circumstances, the replacement must have been by molecules since you see the form of the shell or the sponge so perfectly preserved. And so rarely would these favourable circumstances occur, that we may be quite sure a thousand sponges "died and left no sign" for each one that has left its own monument behind.

And in the case of a sponge which had commenced during life to secrete spicules from the silica in the water, there would be as it were, a starting point for the precipitation of more silica. It is well known for example, that when a dissolved substance does not readily crystallize, it can be made to do so by dropping in a small crystalline fragment, around which as a nucleus precipitation immediately commences. But of course this was occasional. It was not always round a sponge; we get shells wholly converted into flint, and in perhaps the majority of the stones we find no organism at all. The flat cakes of flint that form a striking feature in the chalk cliffs seldom produce any. Yet we are entitled to believe that, one and all, their formation was started by organic matter. Life in ten thousand forms completely covers enormous spaces in some parts of the bed of the ocean, and these might be in an advanced stage of decomposition before the silica gathered over them. Thus all definite traces of them would be lost, except the dark colour of the flint caused by the carbonaceous matter.

Flint does not occur invariably in lines, and occasionally the lines are not horizontal but the silica appears to have filled up transverse fissures in the chalk. But solitary flints as might be expected occur scattered through the rock, and it is these generally which reach a huge size.

The lecture was illustrated by a large collection of specimens, including various common flints, fossils in flint, other forms of silica, Euplectella, &c,, as well as microscopic specimens shown in instruments lent by some of the members.

DECEMBER 8th, 1885.

A large number of members assembled in the Committee Room at the Town Hall. The chair was taken by the Rev. A. L. Hussey, M.A., who called upon Dr, Tyson to read the following paper

ON HYDROPHOBIA,

There are always two difficulties in the way of maintaining a society like ours, viz., to find people willing to read papers, and the difficulty of choosing a subject amongst those who are willing to contribute. I have chosen a not altogether agreeable theme for making a few remarks this evening, but one that seemed to me not inopportune at the present time. Hydrophobia has been written upon, and a paper read some few years ago before the members of this society, by our Vice-President (the Rev, A. L. Hussey), but the more frequent prevalence of that disease, and the novel method of treatment that has been proposed, lead me to treat the subject afresh.

Hydrophobia is an acute disease produced by the inoculation of a specific animal poison, manifesting itself by symptoms due to disturbance of the central nervous system, and almost invariably proving fatal. The above is a good general definition. There are many points in connection with the disease which are of an interesting character and are not generally known. Some of these I will give.

The *Ætiology*. It is never spontaneous in man; the sole cause of hydrophobia is inoculation with the poison of a rabid animal, almost invariably with the saliva, the inoculation being commonly effected by a bite. In about nine tenths of the cases the disease is contracted from dogs; in most of the remainder from cats; in very few cases from wolves and foxes. In passing I may say that the fourth Duke of Richmond, when Governor-General of Canada, died six weeks after the bite of a fox from hydrophobia, in 1819. A most graphic account of this illness was given in the *Morning Post* about a month ago.

The disease has been acquired from a wound received during the dissection of a rabid animal. It is probable, although not certain, that inoculation with the blood of a rabid animal will produce the disease. The poison is not known to be present in any other secretion than the saliva. Inoculation takes place more certainly by a bite on an uncovered part of the body, as on the hands and face, than by a bite inflicted through the clothes. It has followed the scratch of a cat, probably by the animal's saliva being thus inoculated. A healthy dog has communicated the disease by a bite given immediately after it had been fighting with a rabid animal, the saliva of which no doubt was hanging about its jaws.

The disease has resulted from the teeth being used to loosen a knot upon a rope with which a rabid dog had been tied.

It has been asserted that the disease may arise from the bite of a healthy dog, but this is improbable. Cases are on reeord, however, in which the disease has followed the bite of a dog which did not at the time or for several weeks afterwards present the recognized symptoms of the disorder. It seems quite possible that in rare cases rabies may affect a dog as a mild and insignificant malady. It is important to recollect that two thirds of the persons bitten by rabid dogs—even when no preventive measures have been used—escape. The impunity may be due partly to the bites being inflicted through clothes, partly to individual insusceptibility, which has been found to exist in animals as well as in man.

It is rather curious that more males suffer than females. So, too, in dogs. I think that this must be due in the former case to the fact that men, until quite recently, have had much more to do with dogs than women. When I tell you that most cases of hydrophobia are contracted from pet dogs, you will agree with me in saying that, considering the great increase of dogs of this class, there is need of a great deal more supervision than at present it has been thought necessary to bestow upon such dogs.

Children frequently suffer on account of their helplessness, and so are bitten about the face.

In many cities of the East large numbers of ownerless dogs act the part of scavengers, and rabies is said to be absolutely unknown amongst them. In the western world we have learned to associate the "dog days," as being especially pernicious to the canine race, with "Sirius" but it is now an admitted fact that hot weather has little influence in producing rabies. We all must remember the old "dog days" in the hot summer weather, and how at that time every dog used to go about muzzled.

The disease is probably contagious, and in support of this statement it may be said that quarantine and other precautions of a similar kind have hitherto excluded the disease from Australia and New Zealand.

The period of incubation, that is the time between the introduction of the poison into the skin and the manifestation of the symptoms, is longer than that of any other acute specific disease, and is irregularly variable. It is rarely less than a month, the shortest on record having been about twelve days, the average period being about six or seven weeks. In about half the cases it is between one and three months. In some cases it is longer, reaching six, nine, or twelve months.

The *symptoms* of the disease are many, and for the most part characteristic, but I need only refer to those which are especially

prominent. The first evidence of the impending disorder is usually malaise, mental depression, disturbed sleep, and some discomfort about the throat, with a difficulty of swallowing, especially liquids. The attempt occasions some spasm in the throat, which soon, if not at first, involves the muscles of respiration, causing a short quick respiration, a "catch in the breath" resembling that due to the affusion of cold water. In a few hours this increases to a strong respiratory effort, in which the extraordinary muscles of respiration take more part than the diaphragm, or the great muscular partition situated between the chest and the abdomen, the shoulders are raised, the angles of the mouth are drawn outwards, the saliva, which is abundant and viscid, cannot be swallowed. As the intensity of the spasm increases, so does the readiness with which it is excited. The mere contact of water with the lips, or cutaneous impressions, as a draught of air, will bring on a paroxysm, The distress it occasions leads to a mental state which increases the readiness with which the spasm is produced. The mere sight of water, or the sound of dropping water will cause it, (hence the name), and even analogous visual impressions, as a sudden light or the reflection from a looking glass,

Thus, the respiratory spasm, excited by swallowing liquids, which is, as it were, the key-note of the disease, extends on the one hand to widely-spread muscular spasm, and on the other to mental disturbance. In each of these directions the symptoms develope. The spasm, from being limited to the muscles of respiration, may become general and convulsive in character, still excited by the same causes. The mental distress passes into disturbance, in which the balance of reason is lost, continuously, or during the paroxysms.

In the frenzy, the horror of the distress is transferred to the attendants, by whom any discomfort may have been occasioned, and during the paroxysm the patient may attempt to bite them, and even others. Consciousness may so far remain that in the intervals he may beg those whom he regards to keep away. The saliva is ejected with force, and the patient hawks it up with a noise "like a dog." The sight of a dog has been known greatly to intensify the disturbance; and this strangely enough, in cases in which the sufferer had no suspicion of the nature of his affection.

The *duration of Hydrophobia* is usually from one to four days; sometimes it lasts six, or eight, or ten days,

The common cause of death is exhaustion from the attacks of frenzy and convulsions. Sometimes the patient has died in a paroxysm of respiratory spasm.

Unfortunately we know little or nothing of the poison of rabies; most probably the morbid poison of rabies is a living micro-organism, and therein in some measure lies our hope, for there may exist an

antidote for every bacterium that invades our organism, but on this point more will be said by and bye. The actual diseased condition which constituted the chief seat and source of danger in hydrophobia in an abnormal activity of the blood vessels of that part of the central nervous system where the spinal marrow joins the brain. The morbid process in itself is not so formidable a character that it should be feared; nor indeed would there be so much cause for alarm if a similar diseased process occurred in another part of the nervous system. It so happens—unfortunately for the human and canine race—that the morbid agent on which rabies or hydrophobia is practially dependant, developes with the greatest luxuriance, and causes the most damage just in those parts of the brain which are most essential to life. Hence the as yet hopelessness and rapidity of this terrible malady; for the disease doubly deserves this epithet from the insidious and uncertain manner with which it creeps on, and from the at present absolute certainty of its ultimate issue, There are certain diseases which simulate hydrophobia such as tetanus, acute mania, organic brain diseases, accompanied by delirium and convulsions occurring after a bite. Even mere mental excitement, directed to the disease, may determine symptoms of difficulty of swallowing, somewhat resembling the genuine disease, "spurious hydrophobia" as it has been termed. It is important to remember that in some cases of general hydrophobia the influence of the patient's mental state has been very clearly traceable even in the early symptoms. The distinction of genuine from spurious hydrophobia is often rendered difficult by the fact that the latter usually follows suspicious bites, and that the former may be distinctly intensified by the patient's nervous fears.

Strangely enough, nearly all, if not all the symptoms of genuine hydrophobia may be simulated. The following interesting and instructive case came under my notice last year: One evening I was suddenly called by an urgent message to go and see a man brought into our hospital with hydrophobia. On my arrival I was told that the patient had been picked up in Sandgate in a violent fit of spasm; he was carried the whole distance, and had made two or three attempts to bite people on the way. He barked at times exactly like a dog. When I saw him he was comfortably placed in bed,his back was exceedingly arched, and all his facial muscles were rigid. He could not speak, and had refused spasmodically all drink. I cannot here go into my reasons for disagreeing with the diagnosis that had already been made, but I applied a test by means of continual pressure for a few minutes in the hollow just underneath the globe of the ear. The hydrophobia disappeared as quickly as it had come on. The man was ordered to be taken to the Town Hall. The next morning the attack was visited with a month's imprison-

ment, one fortnight for assaulting the police on his way from the hospital to the Town Hall, another fortnight for malingering. It was discovered afterwards that he was a discharged soldier from the 4th Dragoon Guards.

The prevalence of hydrophobia just now is somewhat remarkable. Up to the present time there have been twenty-five cases of hydrophobia this year in London alone, the average annual number in the ten years, (1875-84) being only six.

The *Lancet* of October 31st, says "that the recent mortality from hydrophobia in London has indeed been without precedent since the commencement of civil registration in 1837, and calls for more regulations at the hands of the police. It is not without interest to find that in the Registrar-General's last published annual report that mortality from hydrophobia in England and Wales did not exceed the rate of one per million persons living in each of the five years 1879-83, whereas it averaged two per million in the nine years, 1870-78. The *Lancet* goes on to say that in preventive means must we look for the proper curb to the present serious increase of rabies in London. There does not seem any reasonable doubt of the alarming spread of this direful malady, and those who have witnessed the disease, especially in the human subject, as I have, may reasonably be pardoned if under the circumstances they adopt a somewhat violent attitude in regard to the matter. To witness a poor sufferer shuddering at every light puff of air, to know that every attempt at the swallowing of a liquid will excite the same spasmodic action, and to be aware of the certainty of the approach of death, might at the moment excuse the utterance of a wish that all dogs should be destroyed.

It is of considerable practical importance that the disease of rabies in dogs should be quickly recognized. The ordinary story of a mad dog is that he is killed by some heroic individual, usually by a policeman, but not before several persons—for the most part children—have been bitten, Moreover, unless the animal is foaming at the mouth, wildly excited, and rushing aimlessly about, he is not suspected of being afflicted with hydrophobia, Yet there is no worse form of rabies than the "dumb madness" indicated mainly by intense sullenness. In this form there is paralysis of the lower jaw which hinders the dog from biting, and its ferocious instincts are in abeyance; 15 per cent. of rabid dogs have this peculiar form. The symptoms of what may be termed incipient rabies have long been recognized by veterinary surgeons, and amongst the most striking is the altered tone of the diseased dog's bark. Instead of being clear and resonant it is raucous and dull, and such dogs sh uld at once be kept apart and deprived of the power of doing mischief until the existence of the disease is placed beyond a doubt,

when they should be destroyed. Up to the present time it is not only not known, but no probable conjecture has been formed of the causes which produce rabies. The best cared-for dogs are its victims, whilst others that are totally neglected are rarely attacked. There are three well-marked stages of the complaint in the dog—the first is characterised by melancholy, depression, sullenness, and fidgetiness; the second by excitement by rabid fury; and the third and last by muscular debility and actual paralysis. It is most important to recognize the first stage early in the disease. In the early part of 1774 rabies was causing much alarm in Lancashire, and we find that at a general meeting of the parishioners of Eccles, near Manchester, it was unanimously agreed to strike off the poor's rates all paupers who should keep dogs. They agreed to pay 5s. for every mad dog killed in their parish. In the winter of 1807 it raged in Dover and in some of the neighbouring towns. Many cases of hydrophobia occurred in the human species.

I have left the subject of treatment to the last part of my paper. It is an almost universal rule in the practice of medicine that in proportion as the number of remedies increase for any one disease, so the value of each one lessens. The rule holds good especially in hydrophobia remedies. They are without end, but as far as we know at present, no single "specific" exists. Poisons enter the blood and pass through the circulation in an almost incredibly short space of time, and unless the poison can be extracted immediately, or unless there is some known antidote, the chance of destroying the poison is minimal.

Destroying the poison at the seat of entrance and bandaging the parts above, so as to prevent transit of it, seems at present the wisest treatment to adopt. Of the various remedies and methods of cure the following may be mentioned: various destroying local applications, such as ordinary caustic, chloride of zinc, actual cautery; the actual excision of the wound; and even amputation of the limb itself. This last method was recommended by the late Sir Thomas Watson, who stated, were he ever the subject of hydrophobia, he would readily submit to such a severe measure of treatment. The so called specifics, such as mercury, curara, Calabar bean, have been tried in vain. Turkish baths have also been strongly recommended, but with no effect. Sedatives such as opium, chloral, chloroform, have also failed. Lastly we must consider somewhat in detail the latest and probably the most philosophic treatment, that of Pasteur by vaccination of modified virus of rabies.

In a paper read before this society four years ago on "Germs," I mentioned then the probability of vaccination of hydrophobia taking place. This has since been done by Pasteur, but the success

at present is only problematical. The following results have been obtained in connection with rabies in rabbits. If a rabbit is inoculated with the virus of a rabies stricken dog, the rabbit becomes rabid in 15 days. From this rabbit another is inoculated, and so on in a series, the virus becoming quicker in its effe(t, and the period of incubation proportionately shorter, until the inoculated rabbit dies within seven days after the operation. Thus Pasteur has at his disposal a virus ranging from practically nil to a strength which will kill in a week, and his treatment is accordingly as follows: Taking a dog he inoculates him the first day with the comparatively harmless virus, and on the following day the process is repeated, until at last inoculations are made with virus only a day old, and which is strongly virulent, no bad results whatever following, although such an inoculation would be fatal to an unprotected animal. A dog so treated is alleged to be rabies proof. Pasteur had thus unfailingly experimented with 30 dogs, when in July 6th last a boy was brought to him who had been severely bitten by an undoubtedly rabid dog. From the following day to July 16th the boy was inoculated with virus ranging from a fortnight until a day old, it becoming proved by simultaneous experiments that after the first five days the same virus was invariably fatal to rabbits, and now the boy is exceedingly well and pronounced cured. Pasteur has several other patients under treatment, and expresses the greatest confidence as to results.

In the *Graphic* for November 21st last, there are two excellent engravings of Pasteur and his "experiments for the cure of hydrophobia," yet the above experiments on the human body by no means settle the question that we have as yet discovered a real antidote to hydrophobia. In the first place the boy above mentioned may never have had hydrophobia, even had he not been vaccinated with the poison, for we know already that two-thirds of the people so bitten do not contract the disease.

Again sufficient time has not yet elapsed to show that the poison is destroyed, supposing he had it; for as I have already mentioned, the incubation stage may in some cases last a twelve month.

In yesterday's paper the following telegram, dated New York, December 6th, appeared:—"The steamship Canada, which sails on Wednesday next, takes four poor children from Newark, New Jersey, who have been bitten by a mad dog, for treatment by M. Pasteur. The expenses of the journey have been defrayed by public subscription."

There is still remaining one plan of treatment of a preventive kind, which, if carried out, would probably cause the extinction of rabies entirely, and therefore of hydrophobia. Dr Fleming, in a long and very interesting letter to the *Times* for November 26th

last, draws attention to it, and says that if it were thoroughly carried out the disease might become extinct in 18 months. The plan is that all dogs should be placed beyond the power of harming animals or human beings for a period of some three or four months. Rabies in a dog invariably manifests itself within this period, and the result of this expedient would be that all the dogs at present infected would die within that period and that the survivors would be absolutely free from contagion or the risk of being attacked at any future time. This measure must of course be supplemented by a quarantine of similar duration upon all imported dogs. Dr. Fleming mentions in his letter that in our island of Mauritius rabies is very prevalent and fatal, because little if anything is done to check or suppress it; while in the island of Bourbon, not far off, there has not been a case of rabies or hydrophobia for at least half a century, simply because the importation of dogs is not permitted.

In 1867 a Metropolitan Streets Act was passed which enables the police to seize all vagrant dogs. In 1868 it was put in force, and the number of cases of hydrophobia immediately became greatly diminished in and around London.

The above I believe was supplemented by a measure passed in 1872, but both these measures are not sufficiently stringent as to details to eradicate the disease.

Perhaps, and very probably, our new government may see fit to pass such legislative measures as will banish for ever from our shores this dire disease. If so, this last terrible outbreak of hydrophobia will be accompanied by a corresponding blessing.

At the conclusion of Dr. Tyson's paper, Mr. Ullyett, the Hon. Sec., said he had received a message from Dr. Fitzgerald, regretting his absence, and asking that the following notes might be read :—

When one reflects on the alarming increase of hydrophobia of late, and the deeply interesting experiments of Pasteur, one is almost forced to two conclusions—First, that rabies ought to be " stamped out " by vigorous measures, or, failing that, every bitten dog should certainly be inoculated. Dr. Tyson has pointed out that Pasteur has now succeeded in producing an inoculating virus with a much shorter incubation stage than the natural rabies poison, so that it exerts its protective influence before the other poison has had time to produce its fatal symptoms. It in fact overtakes and overcoms the original virus. For my own part, were I bitten by a rabid dog, I should not hesitate to be inoculated by Pasteur's modified virus, although I know that only a percentage of those bitten are ever affected by hydrophobia. Dr. Tyson has told you only a third part, but I believe the statistics are better than that. Hunter men-

tions twenty-one persons as having been bitten by a mad dog, of whom only one suffered. During the Stockholm epidemic 106 persons were bitten, and of all these only one, who neglected his wounds, contracted hydrophobia. Zoualt, the celebrated veterinary surgeon, has been himself five times bitten by mad dogs, and has cauterised the wounds of 400 people who were bitten, without a single bad result. And I could cite many such examples, proving how very small a percentage of those bitten suffer any serious mischief. In 1870 there died in England of hydrophobia 60 persons; in 1874, 61; in 1876, 73; in 1877, 82; in the other years between 1870and 1883 there died on an average about 40 persons each year, which is only two or three per million. This is a very small percentage, but when we remember the fearful and hopeless suffering entailed by the disease, there is no question that as it can so it ought to be prevented. So hopeless is it that formerly sufferers were in England smothered between two feather beds, and only the other day I heard of a man being treated for the complaint in France by having his jugular vein opened, which was of course equivalent to bleeding him to death. One obvious and easy precaution should at once be at once taken—no ownerless dogs should be allowed to wander about the streets. Each dog should be compelled to wear a collar with its owner's name and address on it. The owner of any rabid or savage dog should be made legally responsible for any damage he may do. This would make people careful. All dogs straying without collars should be destroyed. Any dog bitten by any other dog, rabid or not, should be inoculated. Every dog, for a period of six months from a given date, should be either muzzled, tied up, or led by a string, or otherwise be rendered impotent to bite another dog or man. All this should be made compulsory and penal. Foolish ladies are largely responsible for fostering hydrophobia by injudicious overfeeding of pet dogs and by not affording them proper opportunities for exercise, &c. It does not apparently strike these amiable, over-indulgent ladies that their supposed kindness is really great cruelty to their unfortunate pets, and a great possible wrong to society at large.

A short discussion followed, in the course of which Mr. Hussey cited a case which had come under his notice, in which a perfectly healthy dog had conveyed hydrophobia. Colonel Rotton said he had met classes of hydrophobia in pariah dogs in India, but he admitted it was rare.

In reply to questions, Dr. Tyson said rabies might be conveyed by horses, but he had never heard of its being communicated by a human being. They had no knowledge as to the origin of the disease, any more than they had of the origin of smallpox, scarlet fever, measles, and other diseases. He suggested that dog licenses

should have on the back a description of the first symptoms of hydrophobia, so that the owners of dogs might be able to detect its presence. He was not in favour of increasing the dog tax as a means of reducing the number of dogs because he saw no reason why a poor man who was fond of a dog should not have one.

A cordial vote of thanks was accorded to Dr. Tyson for his paper.

ANNUAL MEETING,

TUESDAY, JANUARY 12TH, 1886.

The annual meeting of the members was held on Tuesday evening, Dr. Fitzgerald, the President, in the chair. The balance sheet showed a small sum in hand.

The Secretary read his annual report as follows :—

"During the past twelve months there have been held six evening meetings of the Society, all of which have been well attended. They commenced with a lecture on "The Spectroscope: Its Structure and Uses," by the Rev. J. Burgess, F.R.A,S., which was beautifully illustrated by him with the lantern and the instrument itself. This was followed by the President's annual address; "Mosses," by G. C. Walton, F.L.S.; "Ants," by the President; "A Flint Stone," by the Secretary; and "Hydrophobia," by Dr. Tyson.

"The second series of our proceedings lies before you on the table, and contains the papers read during last session.

"It has ben suggested that papers on literary subjects should be admitted at our meetings as well as on scientific matters, and I shall be glad to receive offers from any member or member's friend who could assist us in this direction.

"The number of members at present is 100.

"We were somewhat in debt at our last meeting, but I am glad to say that we have cleared that off, although the printing of the proceedings, which, strictly, ought to go into last year's account, has not been paid for."

Mr. Walton then moved the re-election of Dr. Fitzgerald as President, referring in eulogistic terms to the valuable assistance and support which he had for so long rendered to the society.

The Rev. C. Bosanquet seconded. He remarked that it seemed to him that the society owed a great deal—perhaps even its existence—to its excellent President and its not less excellent Secretary. They were not only indebted to them for its prosperity

in a monetary point of view, but also for its prosperty in regard to papers read. He expressed satisfaction at the prospect of the erection of a new museum, which would be connected with the society. —The resolution was unanimously carried.

Dr. Fitzgerald said he felt exceedingly the honour they had done him. He had presided on so many occasions that he did not look on them simply as members of a society of which he had the honour to be President, but rather as his children. Quite a generation had grown up since he had been President. He assured them he should continue to take the deep interest in the society which he had hitherto done.

Mr. Ullyett proposed, and Mr. Knight seconded, that the Vice-Presidents be re-elected, with the addition of the name of Captain Walker, and it was carried.

Dr. Tyson proposed that the Honorary Secretary be asked to continue in his office. His past work strongly recommended him. They had heard how necessary it was to have an able President. He was quite sure they would all agree with him when he said how necessary it was that they should also have an able Secretary.

The Rev. A. L. Hussey seconded, endorsing the remarks of Dr. Tyson.

Mr. Ullyett accepted the post, and briefly acknowledged the compliments paid him.

The President remarked that they were in a tolerably flourishing state financially. Indeed their position was not only satisfactory, but they were actually overflowing with wealth, for one of their most earnest members, who was about to leave Folkestone, had presented the society with the munificent sum of £20 as a donation (applause). The donor was Mrs. Rumsey. It was exceedingly generous of her, and he was sure they would acknowledge with a very hearty vote of thanks the kind gift, which would absolutely be the making of the society.

Mrs. Rumsey, who was present, briefly thanked the members, assuring them the society had been the means of affording her many very pleasant evenings, and that she should always look back with the greatest pleasure to the meetings which it had been her privilege to attend.

ADDRESS.

Although the year which has passed away has not been fruitful in new or startling discoveries, nor even in any invention which has distinctly and visibly forwarded the progress of knowledge, yet there has been no lack of painstaking labour and research on the part of the mighty army of scientific workers. Few amongst us realise the arduous and unrenumerative labour which has to be gone through before any scientific discovery can be made public. The

endless experiments, the tests and control tests made to check and confirm the first; the disheartening failures, the apparently profitless expenditure of time, money, and eye-sight before there can be any tangible result. I cannot perhaps adduce a better instance of the actual commercial value of purely chemical and theoretical experiments than the recent production of artificial alizarin from the waste of coal tar, which was formerly thrown away; and was also a great source of pollution to our rivers. Aniline and a considerable number of brilliant dyes, of great commercial value, have, for some time, been prepared from coal tar; and chemists are hopeful that still more may be yet discovered. Madder was formerly largely used in dying textile fabrics, and was a more expensive article, but now Dr. Perkins has succeeded in producing from coal tar, alizarin, not an imitation or substitute, but the identical chemical substance to which madder owes its colouring properties. One ton of alizarin does as much dyeing as twenty tons of madder. About 3,400 tons are now used annually in Great Britain, which cost £457,000, this would represent about 61,000 tons of madder, which would cost about £2,900,000; thus a saving of nearly 2½ millions sterling has been effected in this industry alone by Dr. Perkins having laboriously followed up a purely theoretical deduction by experimental research.

Never yet, perhaps, were inventors better off than in this our day, for instead of being looked down upon, as they once were, as charlatans or enthusiasts, they are certain of the ready sympathy of an educated public; and aid, in the shape of pecuniary grants, from scientific bodies, and perhaps even from a not too enlightened government. What is still chiefly exercising the scientific mind is the "Germ theory" of disease—the importance of which can hardly be exaggerated, for it bids fair not only to revolutionise medicine, but to profoundly modify, in the future, the lives and health of unborn generations. Dr. Ferrau's inoculations for Cholera have hitherto been an undoubted failure, which indeed might have been expected from the unscientific (and I might add illiberal) method in which they were conducted, nor indeed can Cholera inoculation be expected to succeed until it can be proved that one attack is preventive of another, which we know is not the fact, Pasteur's more philosophical innoculations with a weakened virus, for the prevention or cure of Rabies or Hydrophobia, and Anthrax or Malignant Pustule, have had a much larger measure of success, although they must still be considered on their trial. Unfortunately three of Pasteur's patients have recently died of Hydrophobia, after having been inoculated by him with the attenuated lymph, but this failure was perhaps due to their not having been operated on until a month after they were bitten, which was certainly far too long,

so this result ought scarcely to be allowed to invalidate Pasteur's conclusions, of which, I may add, he is as confident as ever.

Astronomers have not been idle ; they have discovered eight new planets and some six new, or at any rate unrecorded, comets during the past year. But the great event was, of course, the discovery of the new bright star in the Nebula of Andromeda. As our telescopes increase in power and sharpness of definition, so more and more of the supposed Nebulæ are desolved into separate stars or suns, until some authorities are disposed to doubt whether any really nebulous matter exists within our ken.

In America they are making a magnificent telescope for the Lick Observatory, on Mount Hamilton, with a flint glass disc of thirty-eight inches diameter, which ought to make the moon, which is 240,000 miles distant, appear as if only one hundred miles away, and should render visible any object on its surface of the same size as many of our public buildings. The meteor shower of the 17th November last was perhaps the most brilliant and remarkable one is likely to witness in a lifetime, the meteors fell at the rate of fifty or sixty a minute, and about 7 p.m, almost resembled a display of rockets, as many as five or six being visible simultaneously ; as a countryman quaintly remarked "Yer couldn't look at a star but what it run away"! In the north of London they were seen to fall at the rate of 5,000 an hour. Everyone, nowadays, knows there are zones of small solid bodies, tiny worlds in miniature, revolving round the sun in ecliptical orbits, and that these small spheres, travelling at the rate of 1,200 miles a minute, become ignited from the rapid friction in passing through the earth's atmosphere. As the iron and nickel of which meteorites are composed is found to exist in the same combination in certain volcanic products, it has been surmised by some that meteors mav possibly be the fragments of an exploded planet.

Photography has again recently been lending important aid to Astronomy by recording the actual movements of the so-called "Fixed" Stars, and showing the direction of their course through the heavens. So far from being fixed, we know these stars to be whirling through space with a velocity in comparison with which the rush of our earth round the sun, or the enormously rapid movement of that great centre in its own mighty course, is only as the slow crawl of a tortoise. Whither, and through what inconceivably vast empyrean are all heavenly bodies hurrying? Shall we, *can* we ever know?

You will be gratified to learn that a French Savant, M. Mortillet, has discovered the celebrated "Missing link," so long and hitherto vainly sought. In the Miocene Strata he has found (so he says) the fossil common progenitor of man and monkey, and he produces

some rudely chipped flints as infallible evidence of the fact. The wing of a fossil Cockroach (Blatta) has lately been found in the middle Silurian rocks in France, so our domestic friend, with whose presence we could so well dispense, proves to be the oldest of all known fossil insects. Another Frenchman, a M. Ramus, is able to assure us possitively that man has been in existence on the earth exactly 223,108 years, and I think we must admit that the exactitude of the odd eight years renders this a fact not to be doubted.

Mr. Galton's "Composite Photographs" are exciting a good deal of scientific interest, giving, as they do, much valuable information as to the physiognomy of different classes and races of men. It has been recently discovered too that the aid of Photography can be dispensed with and composite portraits obtained on the principle of the Stereoscope. Thus a compound portrait of a girl of twenty and her grandmother was found to resemble neither of them so much as the face of the mother whose age was about forty.

I dare say most of you know Galton's method is to take negatives, of exactly the same size, of a number of different persons of the same class, say for example, naturalists, painters, or doctors, who must all have the eyes fixed on precisely the same spot. Each negative is then lightly printed on the same sensitized paper, one on the top of the other, In this way only the salient points of each face are transferred to the paper, and some very interesting results are obtained, Few people are aware what good service the Japanese are rendering to science, not only in their careful chemical experiments but by their exact observations of earthquakes, earthtremors, and deep temperatures. They have devised a method by which movements of the earth are made, by means of suitable instruments called seismographs, to draw their own movements on paper, thus showing their direct extent; not only have they done this. but by an invention eminently practical and useful in such an earthquake area as Japan, they have contrived a method of counteracting and preventing the disastrous consequences of earthquakes on buildings. This is done by resting the foundations of the houses on small cast-iron shot, of a quarter inch in diameter, placed between cast-iron plates in the piers on which the houses are built, all sudden movements, which is the great source of danger, is thus prevented, and the shock is expended in merely rolling the shot, while the building itself is practically unmoved.

I may here allude to the rather bold project of Mr. Starkie Gardner of utilising the intense heat of the interior of our earth, to supply warmth to the exterior. Of course we all know that the deeper we go beneath the earth's surface the higher is the temperature; the increase of heat was formerly considered to be one degree Fahrenheit for every sixty feet we descend, but some recent

experiments of Professor Prestwick seem to show the mean rate of increase to be one degree for every forty-five feet. Thus at a depth of 10,000 feet we reach the temperature of boiling water, 212 degrees, and at twice that depth a temperature at which all surface rocks would be liquid. Now as we are already quite within a calculable distance of the exhaustion of our coal supply, it is clear that we must ere very long, find some other means of obtaining heat and motive power, and this Mr. Gardener proposes to do by means of deep borings down to the liquid lava which is supposed to underlie the solid crust of the earth. I cannot help thinking this a very wild suggestion, for even were it possible in the present state of engineering science to make a sufficiently deep boring, which I very much doubt, the actual expense would be simply incalculable; and again, supposing the theory of a liquid interior to be true, which is by no means proven, we should only succeed in establishing an artificial volcano, which would not only be a rather undesirable aquisition, but would prove a decidedly unmanageable source of caloric to manipulate!

Believing, as I do, that science should be comprehensible to all, and some knowledge of it should be attainable by everyone of average intelligence, I must here protest against the practice, which is becoming every day more prevalent, of using a pedantic jargon of composite Greek and Latin words where generally plain English would answer the purpose as well, and often far better. Botany, Geology, Palæontology, and even Medicine, are now all crowded with crack-jaw names of this description; it appears as though would-be scientific men were bent on shrouding science in the same sort of mystery as surrounded Astrology and Alchemy in in the middle ages, For instance *Petalorhynchus positlacinus petalonidæ* is a fairly long name for a shark, but it pales into insignificance beside *Amblystomatigrinum mavorticum-hallowelli-suspectum-maculatissimum!* The chemists are not one whit behind-hand with new compound names, such as *Hydroxyisopropyli phenyl-neketone carboxylic-acid*, not to mention giving some half-dozen different names to our old friend carbolic-acid. Professor Mattieu Williams has been recently calling attention to the above absurd pedantries, and he concludes one of his caustic articles with a humourous suggestion that plum-pudding should, on the same principle of descriptive names, be called *sueto-flour-egg-candied-peel-raisino-spice-currant-conglomerate!* Surely the object of teachers should be to render science both clear and attractive, not to envelope it in an incomprehensible verbiage.

During the last year, the cause of Temperance has continued to advance with rapid strides, but I am nevertheless glad to find no less eminent a man than Sir Henry Thompson recently insisting

on a point to which as many of you know, I have often drawn attention, I allude to what I may call Intemperance in Eating, by which, I believe, a greater aggregate amount of injury is done to life and health than by Intemperance in Drinking. We have heard a great deal from temperance writers (not always quite temperately) about the evils of drink, and no sane man, least of all a doctor, would deny the fearful amount of sin and suffering caused by its abuse; but then the thing speaks for itself, and its palpable and immediate ill effects are only too apparent, But with habitual gluttony the case is different, no immediate evil results from it, and an immense number of persons indulge inordinately in over feeding, not only without an idea of wrong-doing, but with a certain self-complacency which is very hard to tolerate. The working man, who really requires and assimilates a large quantity of food, and even beer, is often looked down upon as an inferior animal by those who are habitually consuming an amount of food out of all proportion to their needs. Such persons are not only shortening their own lives by sowing the seeds of disease of the liver, kidneys, and digestive organs in themselves, but bequeathing a fatal heritage of gout, rheumatism, and skin diseases to their unfortunate offspring.

I was much struck by an idea (for it is little more) which was lately mooted in the *Nineteenth Century* and the practical carrying out of which Mr. Balmer pleads most eloquently. The novelty of the idea strikes one at first as almost fantastic, but it carries, I believe, the germs of a great future. I allude to the Reading or Whispering Machine proposed by Professor Nymanover, a Swede. You all know the Phonograph, which is essentially a soft metallic cylinder, so contrived as to record permanently, and to repeat when rotated, words or sounds uttered in the immediate neighbourhood of its diaphragm. It is proposed that small machines constructed on the Phonograph principle, and rotated by clockwork, should be, when required, carried about on the head, concealed of course by the hat, and having a thin wire connected with each ear. By this means men would be enabled to go about all sorts of out-door pursuits or exercises without waste of precious time or still more precious health, for they could enjoy all the benefits of reading without injury to the eye-sight or confinement to the house. It is quite painful to see busy men in a crowded jolting omnibus or dimly lighted train eagerly endeavouring to snatch a little literary food, well knowing that once plunged into the vortex of the day's work all idea of reading must be given up. By the aid of the Reading Machine all this might be altered, they might be stored with any kind of reading thought desireable, and a man might walk in to his business in the morning with words of deepest wisdom, of sparkling wit, or poetry, or even others more

precious still, echoing in his ears, while his muscles were being braced by exercise and his lungs refreshed with pure air, and all without injury to his eyes. The deterioration of the eye-sight in quite recent times is becoming a serious and very pressing consideration. In Germany, where the masses are certainly better educated than with us, nearly thirty per cent. of the labouring class have to wear glasses, while in the higher ranks no less than fifty per cent. have defective sight. In England too the per centage of persons with weak and defective vision is steadily and rapidly increasing. Various means have been proposed with a view to saving the eyes as much as possible, and books have been already printed in dark blue print on a greenish or neutral paper, or black on a buff ground, with this object, but all such devices appear trivial when compared with the saving which might be affected by means of the Reading Machine.

The time at my disposal will not permit me to continue my enumeration, but I hope I have said enough to show you that the past year has not been altogether unproductive of interesting scientific work

In the course of a short discussion which followed,

Dr. Tyson referred to that portion of the President's address relating to sight. He said it was interesting to know that a great many more people were wearing spectacles now. They must remember that the science of testing the eyesight had only very lately come into vogue. He often thought that boys at school many years ago were punished very often for not seeing things on the black board, whereas it was now generally acknowledged that their sight was defective. They knew now that the use of simple glasses early in life would remedy that defect, although they must admit that eyesight was gradually getting weaker.

Mr. Walton asked if that could be explained, when it was well known that the average duration of life had increased during late years.

The President said there was no doubt that sanitary improvements and a better knowledge of hygienic laws had caused the diminution in the death rate. He thought it was to be expected that both sight and hearing would be less acute owing to the higher state of civilisation in which we lived. There was such a thing as evolution, and as organs were exercised so they improved. People living in a more natural kind of life maintained their faculties of sight and hearing to a much greater extent than they do now, when they were living a much more artificial life than formerly.

With reference to over eating, Mr. Walton asked the President if he did not refer more especially to the consumption of animal food.

The President replied in the affirmative. He estimated that people frequently consumed three parts of animal food to one of vegetable, and they would be much healthier if the proportions were reversed. They heard of vegetarians, but there could be no such thing as vegetarianism. They all took milk, which was animal food, and butter which was also an animal product, and they ate eggs in large quantities.

The Rev. E. Hussey thought it should be impressed upon people that gluttony was a vice as well as drunkenness. Boys especially were tempted to over-eat themselves—they were like puppy dogs—if they put a certain amount before them they ate until they made themselves sick. It was very wrong.

The President said there were grown up dogs who were quite as bad as the puppies (laughter). Still the practice was very reprehensible,

A vote of thanks to the President terminated the proceedings.

Tuesday, March 2nd, 1886.

There was a good attendance at the Town Hall, Dr. Bowles, V.P. in the chair. A paper of considerable length was read by J. Smurthwaite, Esq., on "*Darwin and his opinions*," in which the writer agreed with Darwin generally, but stopped short at the "Descent of Man," in which he considered the author had generalized rather hastily.

A short discussion followed in which the chairman, secretary, and Mr. Walton took part. The two latter took exception to the remarks on Darwin's hastiness, believing him to have been one of the most careful and exact men of our time, and one whose induction was very wide.

Tuesday, April 6th, 1886.

The attendance was rather scanty. In the absence of the President and Vice-Presidents, the Rev. C. Bosanquet was voted into the chair, and a short paper was read by the Rev. J. R. Duke, M.A., on "*Man in his relation to the lower animals.*" The subject was treated from an *a priori* point of view, showing that similarities of structure between man and the lower creatures might have been expected, and need not necessarily imply physical relationship.

Tuesday, May 18th.

Dr. Tyson, V.P. took the chair, and the following paper was read by the Secretary on

THE THEORY OF MALTHUS IN ITS RELATION TO DARWINISM.

It is not my intention this evening to traverse again any of the ground over which on two former occasions during the present session we have been taken in connection with the Darwinian explanation of development. I rather wish to bring before you one or two difficulties—they seem to me to be fallacies—in the reasoning of some of the Darwinites, which have lately forced themselves on my notice. It may be that I shall provoke someone to respond, and perhaps to show that these said difficulties or fallacies exist only in my own imagination. If so I shall be glad.

And let me say at starting that I accept and teach development and its Darwinian explanation as an excellent working hypothesis, whichprobably is (but still *possibly* not) a true one. I do so just as I accept and teach the existence of that stupendous marvel, the *ether* in connection with light and heat. I may do so in each case without being compelled to repeat a *credo* with respect to either. In the present condition of our knowledge we cannot do without both. In what I have to advance I shall by no means be alluding exclusively to the arguments of Mr. Darwin himself, but in the majority of instances to those who tread in his steps, and, lacking the trained powers of his mind, try to make his footprints deeper by unfair means.

The title of my paper is "The Malthusian Theory in its relation to Darwinism." It must be understood that Darwin had been led to take up development long before he had read the theory of Malthus, and that therefore his ideas do not absolutely depend upon it, and may be correct regardless of its truth or falsity. But he tells us himself that it threw a light upon some of his difficulties, and guided him on by a path which led him out of them. But most of his followers lay the foundations of the struggle for existence and of natural selection, to a very great extent, if not wholly upon Malthusianism. Grant Allen, in his life of Darwin, goes so far as to say "it is quite conceivable that without the 'Essay on the Principle of Population,' we should never have had the 'Origin of Species,' or the "Descent of Man.' Darwin himself, however, asserts—and this is important in reference to what I shall have to say presently—that the struggle for existence "is the doctrine of Malthus, applied with manifold force to the animal and vegetable kingdoms."

What then is the doctrine to which development owes so much?

In the year 1798 the Rev. Thomas Malthus published his "Essay on the Principle of Population," in which he argued with considerable ability, and as a fact, that it was the tendency of population to increase in a geometrical ratio, while subsistence "to be obtained from land under circumstances the most favourable to human industry, could not possibly be made to increase faster than in an arithmetical ratio"; which, being interpreted means that in certain periods of time (he put them at 25 years), human beings tend to increase according to the numbers 1, 2, 4, 8, &c., *i e.* doubling their numbers every quarter of a century, while subsistence increases as the numbers 1, 2, 3, 4, &c., *i.e.*, adding only an equal quantity during each of those periods. He drew the conclusion that unless something was done, either by man himself, or by the operation of natural laws, to check this rapid increase, the earth would in a comparatively short time be overcrowded.

The essay made a great stir; its principle was accepted, apparently without any very close scrutiny; and with an occasional opponent, and with a few modifications has kept its ground, being adopted in the current works on Political Economy, that science of tendencies destined never to be realized, for which it was well adapted. With occasional opposition, I say, still oftener with a demand for proofs. For after all it is but a tendency;

"Only this and nothing more,"

a tendency which, save at rare intervals, and under exceptional and local circumstances, has never been fulfilled. Malthus, however, argued from it as if it were being constantly fulfilled, and as if it would soon be an accomplished fact for the whole habitable world. But no theory can hold its ground unless facts fit in with it, and there seem to me to be a few which will not accommodate themselves to this one, and notably—that although the earth has been inhabited no one dare say how many thousands of years, and this "tendency" has been at work the whole time, it is not yet fully populated,—it is not half full. How are we then to explain its almost universal acceptance? Well, like many other things repeated over and over again, and especially if repeated in high sounding terms, it gets passively acquiesced in. "Geometrical ratio," and "arithmetical ratio," have a solid mathematical ring of truth about them, and so people accept without further enquiry the statements in which they are involved; just as the electors of a certain constituency accepted a candidate unreservedly after being told that he "had succeeded in the exact rectification of a circular arc, and had likewise discovered the equation of the lunar caustic." Malthus's great example was that of the North American Colonies, the population of which doubled itself in twenty-five years; but this of course was a very exceptional case, and cannot be taken to

prove a universal law, the induction for which must necessarily be very extensive. With respect to the increase of food in an arithmetical ratio only, it has remained up to the present time little more than an assertion; no sufficient proofs have been advanced, and in fact everything points against its correctness, and the theory has of late years been softened down to this assertion simply,—that population tends to increase faster than subsistence. But although deprived of the original mathematical certainty, the consequences deduced from it remain unaltered. Seeing then that this theory has been the basis of other theories both in political economy and in development it may be interesting to us to enquire how far ancient and modern facts fall in with it as regards approaching over-population. What is known of the population of the world in former times as compared with it at present? Was it far below? Was it below it at all? No doubt much is wrapped in the uncertainty which obscures early times, but this ought to make us hesitate equally in hastily asserting geometrical progression and in rashly denying it. Montesquieu, early in the 18th century, expressed what seems to have been then the received impression, that the population of the world had long been declining. Since his time everybody has taken up the opposite opinion. Yet consider for a moment the empires of antiquity, and the enormous populations which must have been necessary to carry out those works of irrigation and architecture, the ruins of which literally cover the face of the earth. We are looking at the world as a whole, not at any limited portion of it. No one will deny that any particular district may be thinly populated at one time and over-crowded at another. Europe is generally pointed out at present as accomplishing the geometrical progression. But after all these centuries of increasing civilisation she does not yet number 86 to square mile. And Asia is not 46. Compare this with Great Britain which numbers 324 to the square mile. The whole world averages 29. The numbers in Asia were once probably very much higher proportionally than in Europe. We have only to glance back over the pages of history to satisfy ourselves that the great centres of population have changed their places repeatedly and rapidly, but they have always been in existence. There is no period of history without its great empires and crowded populations; and all the signs of pre-historic periods point in the same direction in each hemisphere. Large areas now barren and desolate were once thickly peopled and highly cultivated. Nowhere is this more evident than in west and south-west Asia. The valley of the Syr Daria is said to have been at one time so thickly settled that a nightingale could fly among the fruit trees along its whole distance to the Sea of Aral. The whole country from this river to the Nile

has been a seat of huge kingdoms and empires. The valley of the Helmund in Afghanistan, we are told by a recent traveller, is "strewn with the relics of dead kingdoms." Along the valleys in China, among the sands of Gobi, and in the forests of India, unnumbered ruins and gigantic structures tell us of vanished peoples. And the Euphrates and Tigris valleys are still yielding their testimony to the existence under the old Assyrian and Babylonian empires of a magnificent system of "intensive cultivation," as it has been well called, which supplied the wants of huge multitudes of people. The ruins in Asia Minor tell the same tale. Look at that part of the world, and you would say population has wonderfully decreased; look at modern Europe, and it appears to have increased; the simple fact being fluctuation, here at one time, there at another.

What of Africa? In the palmy days of Carthage 300 Lybian cities paid her tribute; how many "cities" are there now? When Agathocles, king of Syracuse, invaded that part of northern Africa in the 3rd century B.C. "the whole country lay like a garden before him, covered with wealthy towns and the luxurious villas of the Carthaginian merchants. Two hundred towns or more surrendered." Some further idea of the geometrical increase of North Africa is afforded by Gibbon, who tells us that 500 episcopal churches (*i.e* bishops' sees with all their surroundings) were overturned by the hostile fury of the Donatists, the Vandals and the Moors. But how has the Malthusian Theory worked since then? Where are those peoples now?

If we turn to the New World the records are necessarily nearly all prehistoric; but undoubtedly Mexico and Peru were, when invaded, the seats not only of higher civilisations than at present, but of at least as thick populations as now, if not much thicker. And the earth mounds in the United States, the cliff habitatations in the Rocky Mountains, the architectural ruins in Central America, tell us yet again of former centres of life and activity.

No; the earth is little if at all more crowded now than then, as far back as we can trace. There is nothing to back up the geometrical ratio; at any rate nothing which advances it beyond a "tendency," which can no more be realised than the asymptote can touch its curve.

What then are we to think of the following emphatic statement of Grant Allen?—"The world is perpetually over populated. It is not, as many good people fearfully imagine, on a half comprehension of the Malthusian principle shortly going to be over-populated; it is now, it has always been, and it always will be, pressed close up to the utmost possible limit of population." With reference to man, I have proved that this cannot be true, and what I have to

say presently will similarly show that it fails to apply to animals and plants generally.

Yet he and others tell us that this is the basis, the origin of the struggle for existence. "Reproduction is everywhere, and in all species," he says, "outrunning means of subsistence; and starvation or competition is for ever keeping down the number of the offspring to the level of the average or normal supply of raw material.

And Darwin himself asserts this geometrical increase to be the cause of the struggle. Malthus applied the principle to man only. Darwin applies it equally to all animal and plant life. From which follow curious conclusions. Correct me if I am wrong in pointing out how this application of the principle breaks nown.

Man, says Malthus, increases geometrically.

His food increases arithmetically.

Therefore the end is starvation.

But his food consists of animals and plants. And Darwin says they increase geometrically. Therefore there is no danger of starvation; consequently Malthus was wrong.

Again, according to the Darwinites generally, animals increase geometrically and their food arithmetically.

But, the carnivorous animals feed upon other animals, which likewise increase geometrically. Which is absurd.

And if animals feed on plants, still according to the hypothesis, the plants increase also geometrically.

The whole application breaks down, at whatever point you test it. And therefore, though Malthus set Darwin upon a certain track of thought, we cannot look on Malthusianism as forming any part of the real basis of natural selection. Directly Darwin applied it to animals and plants he, *ipso facto* disproved it with relation to man. No single law, no single "tendency" in nature is ever allowed to act alone, and therefore none ever completely fulfils itself. Every effect is a resultant of many tendencies; no cause, no antecedent remains unchecked.

Still it is a fact that Nature is wonderfully prolific; we are tempted at times to think wastefully so. So far as the mere simple arrangements go for the continuation of the species of either animals or plants, the geometrical ratio is an exceedingly high one. It is not a case of doubling in 25 years; it is often a "tendency" of a thousand-fold in one year. Count the number of corns in a cob of maize, and multiply it by the number of cobs on one plant, all from one seed. You will find in some cases the ratio is not limited to one or two thousand Huxley says that a single plant producing 50 seeds a year would, if unchecked, cover the whole globe in nine years. A single red campion will produce 3,000

seeds; in one capsule off a poppy plant 40,000 seeds have been counted.

Pick up the next puff ball you find in the fields, and as you press out the brown dust into the air try to imagine how many millions of grains there are; each one could produce a new puff ball. Or note again the spores on the back of one pinna on the frond of a fern; muitiply that untold number by the number of pinnæ, and that again by the fronds on one root.

And so in the animal world. Look at the mass of frog spawn in our ponds in April; see the countless thousands of tadpoles from it that blacken the bottom of the ponds in May. The herring lays from 30,000 to 70,000 eggs; the lobster 30,000; the oyster 1,000,000; the sturgeon 7,000,000; the cod 10,000,000. Darwin tells us that the progeny of a pair of elephants might amount in 750 years to 19,000,000. Only it doesn't.

Now if we took our standpoint on these facts; we might well look forward and ask how will all this end? The Darwinites, like the Malthusians, do take their stand here, and say that in consequence of the enormous progeny of animals and plants, "by far the greatest number must always perish from generation to generation for want of space, of food, of air, of raw material. "The struggle for existence," says Darwin, "inevitably follows from the high geometrical ratio of their increase." And again, "this geometrical tendency to increase must be checked by destruction at some period of life."

Miss Buckley, in a short account of Darwin states, "All living beings multiply so rapidly that there would be neither room nor food enough upon the earth for them if they were all to live; therefore immense numbers must die young."

Malthus reasoned as if it were an actual fact that population doubled itself every quarter of a century and argued from it that we must apply checks to the increase, as if natural laws were ineffectual; and that if we did not adopt some checks then nature in her rough and pitiless fashion would apply them in the forms of starvation and disease. But it is evident that if he was mistaken in the disproportionate increase of man and his food (and the very application of his theory by Darwin proves that he was), then all the argument he built upon it falls to the ground. But now in the struggle for existence it is not argued that any checks applied by man are necessary; we are told that nature herself provides them in the form of starvation, disease, or the existence of destructive agencies, such as carnivorous animals, parasites, &c. See now what this involves. We are required to believe that the Creator first endows every living thing, whether plant or animal, with the power of multiplying by a high geometrical ratio; and that having

done so he afterwards calls in the agencies I have mentioned, which may be called anything except beneficent, to counteract this power of increase, I cannot look upon Nature so. It involves self contradiction in the Creator. It is looking at things in the wrong way, beginning at the wrong end of the chain, putting the consequent for the antecedent, and *vice versa*.

Let us view it all from another point. Suppose that instead of beginning with the Malthusian "tendency," we start with the fact (as fact it is), that a small proportion of either seeds, young plants or the young of animals come to maturity, and ask ourselves how the species can ever be kept up. I mean that instead of imagining those destructive agencies to be the consequence of great fecundity, we may, I think, look on the Malthusian "tendency" as a provision against the evil results (at least they appear evil to us) of the destructive agencies. I think we have quite as much right to regard Nature from this point of view as from the other, and the mind does not so readily revolt from it.

It is a great fact that plants have not only to reproduce their kind, but to serve as food for animals. Also that one class of animals have to serve as food for another, as well as to preserve their own species. Just as man has a work to do in the world among his fellow men and among his fellow animals, so the lower animals and the plants were created for other purposes besides that of reproducing their kind. The seeds of plants are used not only as germs of future plants but as food for hosts of animals; and even when regarded only in the reproductive light, we must remember what a large proportion decay without ever performing their allotted function. Darwin himself occasionally takes the view I am advancing, "A large number of eggs," he says, "is of some importance to those species which depend on a fluctuating amount of food, for it allows them rapidly to increase in number. But the real importance of a large number of eggs or seeds is to make up for much destruction at some period of life. . . . If many eggs or young are destroyed, many must be produced, or the species must become extinct." I cannot help thinking it preferable that, instead of asking why all this destruction? and answering by the fecundity of plants and animals, we should ask the question, Why is nature so prolific, so bountiful? Why do fishes yield their eggs by millions, and flowers their seeds by thousands? Is it not because they are made subservient to other purposes besides reproduction? And because each does not get its fair chance in the world of life, does not even enter on the struggle for existence? It may fall as a seed by the wayside, it may serve as food for other creatures. Whenever herrings lay their eggs the flat fishes congregate and devour them by thousands, and get thereby in their

turn caught by the fishermen who know their little weaknesses. And every shoal of herrings is pursued by mackerel, codfish, and dolphins; and the unfortunate outsiders are seized, and those who crowd for safety in the middle near the surface are snapped up by gannets and gulls. What species of plant or fish could survive if each produced only one or two germs. Curious calculations are found in some books on birds concerning the number of caterpillars they devour, and the reader is supposed to draw the conclusion that the birds are appointed to keep down certain classes of insects which otherwise might become a pest to man. But the birds ate caterpillars long before man was brought upon the scene.

The house sparrow has been credited with bringing to the nest "forty grubs per hour, making an average exceeding 3,000 in the course of a week" (Wood). A pair of blue titmice have been credited with destroying 500 caterpillars daily, "being a minimum of 15,000 during the few weeks employed in rearing their young. (Ibid.)

Now it is all very well perhaps to imagine the sparrow and the titmouse to be the appointed scourges of the insect race. But we may look at it in two other ways; first, how would these birds fare if the insects did not multiply by thousands? and secondly, how would the insect race be otherwise preserved under such circumstances?

And once again what becomes of the Malthusian increase of animals beyond food when in this case the food multiplies in a far higher geometrical ratio than the birds? Grant Allen triumphantly remarks "*Aut Malthus aut Diabolus*," to which I can only answer "Not Malthus."

Besides, there is a similar abundance and apparent superfluity in other departments; and we must apply the ssme reasoning in both cases. Look at the excessive abundance of pollen produced by anemophilous plants; we can all see that it is because of the multitude of chances against any individual grain reaching the stigma. Sir John Lubbock says that with wind-fertilised flowers "by far the greater part of the pollen is wasted; and much more must therefore be produced than in those cases where the transference is effected by insects."

A single head of dandelion has produced 240,000 grains of pollen, two or three of which would suffice to fertilize each ovule. "It has been stated" says Balfour "that a single plant of Wistaria Sinensis produced 5,750,000 stamens, and these, if perfect, would contain 27,000,000,000 grains. In a single flower of Maxillaria F. Muller estimated the pollen grains at 34,000,000. This same flower produces 1,756,000 seeds."

Why? Surely because of the risks against success. But on

Malthusian and Darwinite lines of reasoning there ought to be some special agencies provided for the purpose of hindering the pollen doing the work for which it has been created.

Which, I would ask, is the preferable mode of looking at all this? To start with the fact of a generous bountiful arrangement for the continuance of life in its varied forms, and then to check it all by an arrangement in which

Nature, red in tooth and claw
With ravine

does her utmost to nullify it; or to take the fact of the risks to which all forms of life are subject, and then to look back to the same bountiful provisions by which the full powers of evil are averted? In the one case apparent cruelty is evoked to interfere with a beneficent arrangement; in the other the destructive agencies are foiled. I do not enter now at all upon the question of apparent cruelty in nature, as evidenced by destructive agencies, why they are here, or whether the cruelty is real, or kfndness in disguise. I am taking facts as they are, and propounding a method of looking at them different to that which so many Darwinians put before us. And here I leave them.

I wish in conclusion to remind you once again that I have not been arguing at all against the Darwinian Theory, which as I have said may be true or false, regardless of Malthusianism; but only against an incorrect method of arguing which is very common, and which when detected, shows discredit on a theory which may be otherwise sound.

At the close of the reading, a few remarks were made by the Rev. A. H, Duke, the Rev. Mr. Bamber, Mr. Smurthwaite, and others, and the meeting closed with a vote of thanks to Mr. Ullyett.

Saturday, June 26th, 1886.

Members went by train to the Warren, but the attendance was small.

The following paper, well illustrated by diagrams and specimens, was read by G. C. Walton, Esq., F.L.S., on

SOME OF THE COMMON OBJECTS OF OUR SHORE.

Certainly the most conspicuous objects of our shore are the large olive-brown seaweeds called kelpweeds, and these, though they lack the delicacy and beauty of many of the red species, yet claim our attention on account of their value. Before the adoption of the modern chemical process, carbonate of soda was extracted from

the ashes of several kinds of rockweed, notably *Fucus vesiculosus*. At the present time iodine, in combination with sodium and magnesium, is obtained from the ashes of Fuci and Laminariæ. As manure for the land, the large seaweeds are collected in great quantities by the peasants of Western Ireland, and as food for man and beast, they are highly valued in many parts. Before passing on, I may remark that the student who will take the trouble to examine the "conceptacles" of a Fucus will be well rewarded for his pains.

A very free grower on our rocks is the Irish Moss, a red weed; grandly called *Chondrus crispus*. It is a very variable plant, in form and colour, and is therefore trying enough to the learner; but it claims notice as a "thing of beauty" on account of its iridescence. Its raindow tints are lovely. *Corallina officinalis*, common coralline, was formerly a sort of *pons asinorum*, being looked upon as an animal production, but it is without a doubt a true seaweed, one of a group possessing the power to take up chalk from the water and build up a mineral framework. The chalky weeds are numerous. Some of them, being merely incrustations looking like lichens on the rocks, would not be noticed were it not for their bright colours. These plants have been called Nullipores.

Among the common objects of our coasts are many interesting plants, large and small, and it would be pleasant to stay awhile amongst them. But our rocks and sands furnish a home for animals as well as plants; indeed, in parts, are coast is "all alive" with curious creatures. Our beach, again, is at times strewn with things, some of which do not belong to us at all, whilst others are washed up from beyond low water mark. It is not possible to say what is really our own, because no dredging has been done. Perhaps one of these days the Folkestone Natural History Society will be rich enough to plan a dredging expedition, with our esteemed Secretary as its head naturalist, Should an assistant be wanted, possibly he might be found.

Some of my audience are no doubt familiar with the hydra—not the fabled monster with many heads which Hercules killed, but the little polype. It is a little fresh-water creature, from a quarter to half an inch long, and of extremely simple structure, for it consists merely of a stomach and a mouth, which is surrounded by a ring of tentacles or arms. *Hydra viridis* is plentifnl in ponds, where it is very often attached to the little floating leaves of the duckweed. Its integument consists of an outer and an inner layer. The arms with which, as we should suppose, the creature catches its prey are provided with cells, which enclose threads—lassos, as Miss Buckland calls them. Threads are really thrown, in lasso fashion, round and into the body of the unfortunate victim that comes

within the clutches of the merciless polyp. The hydra produces young by budding, and does not seem to object to being turned inside out or cut into pieces. Should these remarks on a fresh water creature have seemed like a digression, it will now be seen that they are not really so, because the hydra is the type of a very large number of marine polyps, to which the term hydroids is applied. They are like the hydra itself, hollow-bodied animals belonging to the great sub-kingdom called Cælenterata, which is wide enough to take in such interesting creatures as the jelly fish, the sea anemone, and the coral building polyp. Those whitish branched plant-like things that are found on the beach in such plenty, and are so commonly called seaweeds, are zoophytes or colonies of hyroid animals. Thousands of the tiny animals, polypites as they are called, often inhabit a single polypidom, each animal being lodged in a hydrotheca, and all the members of the colony being organically united through the common flesh that runs down the stem. It is by budding—much as plants bud—that the colony is built up from a single animal, and, of course, the polypidom itself is formed by the united work of the animals themselves. The tentacles of the hydroid animal are furnished with thread cells and darts, like those of the hydra itself. *Sertularia abietina*, a deep-water species (specimen), is very commonly seen (Hincks, vol I., 266; vol. II., p, 55) growing on the shell of the common scallop. Fine specimens are as much as a foot high, and branched bipinnately, are very handsome. Each little polypite has the mouth furnished with about 26 or 30 tentacles.

Hydra-like animals are very numerous, and are divided into many genera, to only one of which—*Tubularia*—your attention is asked for a minute or two. *Tubularia indivisa* (specimen) grows on our rocks, and is most likely plentiful here and there, The colony is made up of a number of simple stems, often twisted and interwoven at the base. Each stem has a thread of flesh running down to the root, and is crowned with a deep red polypite, of the beauty of which words cannot give any proper idea. The writer, who has seen this lovely animal-plant, with the plate-like tentacles spread out, would fain dwell upon its charms, but time forbids. and it may be that we do uot all see with the same eyes. However, let the coloured plant tell its own tale, Professor Allman, in the work now before you, has described and beautifully figured the Tubularian Hydroids;

Wonderful creatures are the well-known jelly fish or sea nettles —the medusæ of naturalists. In Cuvier's Animal Kingdom they are called Acalephæ, on account of the stinging and smarting that is caused by contact with them. Certainly they are not quite bad enough in their tastes and dispositions to be fairly named after

Medusa, the Chief of the Gorgons. It is in summer, when the sun shines brightly and the sea is calm, that we see most of our friend the jelly fish. They leave the deep water and come to the shore in immense numbers, and their visits do not increase the joys of timid bathers. No doubt many different kinds honour us with their company, though it may be we have not taken any particular notice of them. They are indeed curious things, made up of a little jelly and a good deal of water, but still rather highly organized. They sail along by expanding and contracting the umbrella, as the convex body is called, and moving the hanging "stalks" and tentacles (illustration). But most noteworthy of all is the fact that many members of the great medusa family cannot be called independent organisms, as they are budded off from the stems of certain hydroids.

The medusæ are probably the most numerous of all marine animal-, Immense numbers of them are microscopic, and these tiny creatures play a very important part in the phosphorescence of the ocean. Probably few, if any, marine animals excite so much interest and wonder as the Sea Anemones. They are, indeed, curious things, but there seems no reason why they should be called anemones. The expanded tentacles are sure to make us think of the vegetable kingdom, but there is much more likeness to a compound flower than to an anemone. The polype now under notice though one of the hollowbodied animals is, less simple in structure than many of them. The student may, perhaps, without being called hard names by anti-vivisectionists, see for himself what the inside of an anemone is like by simply cutting the creature into two or more pieces. What the views of the polype may be we cannot tell, but of its marvellous powers there is no doubt, as a mutilated body can readily repair itself, and even a small detached part can reproduce the larger missing portion. The commonest species of sea anemone cannot be called handsome, for it is not gaily coloured like many of its brethren It is very beautiful on our coast where it is found on the rocks and in the sand, It rejoices in the name of *Actinia mesembry-anthemum*. *Actinia crassicornis*, with its thick tentacles, is a much more handsome species, and not uncommon all along our coast It has graced many an aquarium, to the delight of wondering spectators, and not being a great traveller, has not seemed to object to limited quarters. It can go a long time without food, but still it devours in very determined fashion any food it may chance to get. The tentacles grasp the prey very firmly and drag it into the accommodating mouth. The writer hoped that his hearers would turn to some of the books, and increase their knowledge of the curious and wonderful polypes, the sea anemones.

On the under surfaces of our rocks will be found plenty of a white or red finger-like, unattractive thing. Its common English names are not elegant, but its grand title is rather pretty, *Alcyonium digitatum.* It is either simple or else branched so as to resemble fingers, and to earn the name of dead man's fingers. In truth, though name and appearance may be both forbidding, the Alcyonium is a most interesting thing. It is, indeed, a polypidom —the abode of many polypes which may be seen very readily. Alcyonium brings us very near the true coral, from which it differs in being leathery instead of hard and chalky. The term coral is widely applied to a good many structures built up by polypes and differing greatly in shape and plan. Books tell us of a West Indian coral called sea fern, on account of its feathery lace-like appearance, which is found, after certain treatment, to be a good material for ladies' hats. The sea fern, which is a floating coral, shaped much like a fern, is never found here, but it claims mention because it is described in many books, as one of the most curious of marine productions. For information about corals we must look at the subject at our homes. We may easily get specimens of Alcyonium and place them in sea water to see the polype put out their bodies and extend their eight pointed tentacles. We must now leave the hollow-bodied animals and step up to the spiny skinned Echinodermata. Here we introduce ourselves to the well-known Echinus or sea-urchin, and the still more familiar star fish. Some plants we know by misleading names, but none of them are so wide of the mark as the common names of some marine animals. Why should we talk of star fish and call a crab a shell fish? The sea urchin is unfortunately, not a "common object" with us, so we may not stop to examine either the animal itself or its prickly house. Will you read for yourselves how the spires are connected with the shell by a ball and socket joint—the most perfect kind—and how the shell increases in size?

The common star fish abounds on our rocky coast chiefly at extreme low water mark. It is one of a large family formed on the same plan, but varying greatly in size, and in the length of the arms, which are often branched. All members of the family have the habit of throwing off some of their arms, and one fellow (called a Lindia), when terrified, is apt to jerk himself into many pieces. What can we make out of a sluggish star fish? Let us see. The upper surface is rough and tough; the arms or rays are simple, and usually five in number, and at the end of each is an organ that does duty as an eye. On the under surface the mouth is situated in the centre, and there are rows of openings from which project the feet or suckers as they might be called. It is by means of these that the animal takes its walks abroad. The starfish is higher in

organisation than any creatures already noticed, and amongst its advantages is the possession of a distinct nervous system. Experiments prove that, whatever power of vision the creature may have, it has in a marked degree the sense of smell. His appetite, too, is good. He is fond of such things as oysters, which he is able to get at in less time than some of us would require for the same purpose. Many worms live in the sea and build for themselves stony tubes. These tubes are firmly attached to the rocks or to the shell, and they afford great protection to the animals which are able to draw themselves quite back, and then to close the door. Species of serpula are abundant here, as elsewhere, and their breathing organs which they put out are like beautiful little scarlet fans. All the marine worms do not make a hard tube to live in, as some of them are content with a pliable tube to which grains of sand, small stones, and pieces of shell are attached. A familiar example is seen in the Terebella (specimen) which may be found sticking erect out of the sand or mud. The broad fringe at the top of the tube might be taken for part of the worm, but it is only a part ot the tube, but it does not seem to serve any special purpose.

Every fisherman knows the lugworm, or lobworm, which is much used for bait. It has to be dug out of the sand or mud, where its presence is known by the mark on the surface. The worm is several inches long, and though not just the kind of thing ladies would like to handle, it is well worth a careful examination. It is a dorsibranchiate which simply means that its branches or breathing organs are on its back. Amongst the lower animals the gills (for such they are), vary greatly in form and position, and the differences are of much value in classification.

The sea mouse, which many of us have admired, is really a sort of short thick worm, and a dorsibranchiate. It is grandly called Aphrodita after one of the nymphs. As we find it on the beach left by the retreating tide, it is a dead-alive thing, but no one can help noticing its splendid tints. The body is oval, three or four inches long, of a brownish grey colour, and silky. On the sides are rows of stiff spines mixed with hairs which reflect all the colours of the rainbow. The tints of orange and green are specially brilliant. The creatures gills are arranged in pairs along the back, being covered by scalyplates. Any doubts as to the affinity of the sea mouse with worms will soon be set at rest by an examination of the ring or segments of the body. Should the hairs and spines present a difficulty, it must be said that the common earth worm is furnished with bristles, and is not the smooth-bodied animal we may take it to be. We should not have expected to find worms bearing the names of nymphs such as Nereis, Euphrosyne, Eunice, &c., but many of them are so gaily coloured as to deserve the

distinction. It is an odd fact, that instead of courting admiration many of them spend a good deal of their time buried in the mud.

Shell fish (?) are to be found on almost every coast. Naturalists aptly call them crustaceans, clearly because the body is covered by a hard chalky shell (carapace), which the animal is able to cast off when the house becomes too small for its tenant. We have all seen juvenile crabs scampering over the sand, and perhaps have learnt experience from incautiously handling them. It is bad at any time to get one's finger in a pair of pincers, and the grip of a crab's claws is no exception to the rule. A Frenchman who was making a dictionary described a crab as a red fish that walks backwards. This definition would be admirable but for an entire absence of truth, inasmuch as the creature is not red, and is not a fish, and does not walk backwards. But let us be students for a moment, and see what kind of thing a crab really is: Structurally it is not at all unlike an animal. Its body is made up of about twenty-one distinct pieces or segments held together in a good measure by the skin. There are ten jointed legs, and a short tail, and the compound eyes are placed on moveable stalks. There are two antennæ or feelers. The breathing organs are not lungs nor spiracles as in the insect and spider, but branchiæ or gills arranged in plates (lamellæ), attached to the basis of the smaller legs, and are admirably suited to a creature that lives in the water. From time to time the crab is obliged to cast its shell and make a larger. The feat is a necessity because there is no provision for the expansion of the shell. In the case of the echinus or sea urchin there is a wonderful araangement for the enlargement of the covering as the animal grows, but the poor crab has, like his brother the lobster, to toil and toil until his task is completed. Does the crustacean inflict much pain upon himself? However that may be, he is alive to some sense of danger, so for safety he takes his soft body into a hole and proceeds to make a new house. *Cancer Pagurus*, for such is the name of the large edible crab, is very fond of fighting, and while he savagely mutilates his opponent he, of course, is apt to lose a limb or two himself, but it doesn't matter because he can easily provide himself with another leg or two. Then again the big crab will eat the little one, merely proving that he is a cannibal. Several kinds of crab are found on our coast, and others (such as the spider crab and the thornback crab) are often brought up in mackerel nets. But the hermit or soldier crab must not be left out. Except on the upper part of his body he is without armour, and being conscious of weakness, he pushes himself stern first into an empty shell—one he may have found empty or it may be, one from which he has cruelly dragged out its rightful owner. "All is fair in love and war."

The shrimp is a crustacean with a long body and a substantial tail by which it is able to dart very swiftly through the water. The acorn shell or barnacle may be found almost everywhere. It differs from the true barnacle (which was once connected with a most absurd superstition) in not having a stalk, so that the body is all enclosed in the little shell. This shell is composed of several pieces and is firmly fastened to the rock. The little animal is called a cirrhopod, because its feet are so beautifully cut in feathery fashion.

Some of my readers will be wondering why not a word has been said about shells and the animals that live in them, The reason is that, working upwards, we have only just reached the soft-bodied animals or, as naturalists call them, the Mollusca. They rank first amongst invertebrate animals, the highest amongst them being the cuttle-fish and its allies. A short time since a cuttle-fish was brought up in a mackerel net at Sandgate, and the writer has seen a living octopus that had found its way to our rocks. Just fancy what a scare there would be if these delightful creatures were to become "common objects of our coast." Animals that have feet growing out of their heads, as these have, are not very likely to win favour, but, when we come to the suckers, it is time to talk about something else. Please notice a very, very common washed-out looking thing, often called a sea weed, but correctly Flustra, one of the sea-mosses or sea-mats. It is a skeleton, a thing that was the abode of innumerable tiny animals now classed as molluscoida. They rank much higher than the little hydra-like animal, and are akin to the proper molluscoida. An examination with a magnifier will show us that the surface of the flustra is not smooth, but is covered with little holes in which the animal lives. About 150 years ago, a great botanist studied the flustra, the alcyonium and the tabalaria, and declared them all to belong to the animal kingdom. Until that time everything of the kind, coral included, was believed to be vegetable. A learned man had proved to his own satisfantion that coral was a plant, and that the eight tentacles of the polype were the petals of the flower. In the field of natural history, as in many another, it is very interesting to see how slowly but surely truth has won the day.

There is a whitish thing that is often seen on some the finer sea weeds, nearly covering them with a scaly crust. It is one of a large number of things allied to a flustra and is called Lepralia Very many of the soft-bodied animals live in shells, as see our friend the snail. A shell is, to my mind, a thing which, even when not elegant in form or bright in colour, may well fill us with wonder and admiration. Its value to a soft defenceless creature is evident, but how is it made? Molluscs are provided with a kind of thick

skin which more or less covers the body, and is called the mantle. This organ has glands which secret the solid matter of which the shell is built and by which it can be repaired when damaged. Many molluses—the oyster, for instance—have no head, whilst others, such as the snail, are favoured with that most useful member. The headless fellows are, as you might infer, of lower organization than their brethren, and they are aquatic animals with a shell composed of two pieces, We have no bivalves on our coast except common ones. You will at once think of the cockle, the mussel, the scallop, and perhaps also of solen and two or three others. The two valves of the shell are hinged and are controlled by powerful muscles. The scallop "flies" through the water by opening and closing the valves; the mussel anchors itself to the rocks by means of extremely tough fibres called a byssus, while the cockle and the solen bury themselves in the sand.

The cockle has a foot, and is able to leap gaily across the mud. I have not yet been fortunate enough to catch the fellow in the very act. The solen works itself with great rapidity into the sand, often to a depth of a foot or more. The most interesting of our bivalves is the pholas. This creature is able, somehow, with its slender shell to bore holes not only in the clay but also in rock. The holes in which the animal lives and dies, are not of uniform diameter, but are suited to the shape of the shell.

Lastly we arrive at the univalves. The animals are gasteropods or stomach-footed. Examples are the whelk, the familiar "winkle," the purpura, and the dog whelk. Thousands of empty whelk shells are thrown up on the beach, and the living animals inhabit our rocks. The purpura claims notice as the animal from which the rich purple dye was obtained long years ago.

The limpet is a univalve without a spire. It fixes its shell most firmly to the rocks by creating a vacuum, and so bringing into play the pressure of the atmosphere, which, as you know, is no trifle. Only a word more need be said, and it is this: Some good will come out of our meeting this afternoon if there is stirred up within us a desire to dnow more about "The wonderful works of God." It was kind of Mr. Ullyet to entitle this paper "Some of the common objects of our shore." Only a few have been noticed. "The harvest truly is plenteous."

Folkestone Natural History Society.

Established for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the summer one or two field excursions are taken.

The subscriptions are of two classes, one Five Shillings per annum, the other Two Shillings and Sixpence. Anyone wishing to join should communicate with the Secretary, at 98, Dover Road, Folkestone.

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PROCEEDINGS

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FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS.

NINETEENTH SESSION, 1886—1887.

OCTOBER 12TH, 1886.

The first meeting of the Session was held at the Town Hall, but owing to the great inclemency of the weather, the audience was not so large as usual. A highly interesting lecture was given by Dr. Gorham of Tunbridge, on "The Colours of Leaves in their relation to White Light." It was illustrated by numerous diagrams, and by experiments with the Colour Top. A vote of thanks was warmly accorded to the lecturer.

NOVEMBER 16TH, 1886.

The following paper, prepared by Dr. Thomas Eastes, was read by the Secretary, the writer being confined to his house by illness.

ON SPONGES.

Mr. President, Ladies and Gentlemen,—I ask your attention to-night whilst I say a few words about SPONGES: a group rather low in the animal kingdom, with a remarkable diversity of minor

characters, and yet united closely together by a fundamental similarity, and at the same time separated from all other animals.

Let us first take a Bath Sponge and examine it closely. What we know as the Sponge is simply the skeleton of the animal, a delicate elastic network which still presents a faithful model of the general form and structure of the whole, after all the other tissues are removed. There are several kinds of Bath Sponge, but we shall take the fine Turkey Sponge, *Euspongia Officinalis* of which there are several well marked varieties, differing greatly in form. Some are cup-shaped masses with thick walls, or more or less globular clumps; others flat plates and others encrusting patches. The colour of the outside is usually brown, varying in shade within; it is generally paler, but in one variety a rusty red colour. A thin skin covers the whole surface of the sponge rising tent-like about the projecting ends of the chief fibres of the skeleton. These projecting ends can readily be seen with a lens on an unused skeleton of a Bath Sponge. In various places, irregularly distributed, the skin is perforated by circular holes known as *oscula*, which I shall call "little mouths" which can be opened or closed. They are the openings of wide tubes which come from the inside of the sponge, being formed by the repeated joining of many smaller tubes. I will call these tubes the outward channels, they are very visible in our sponge. Over the surface of the Sponge, where there are no little mouths, a number of ridges are seen descending, like the spokes of a wheel, away from the centre, but branching as they go, and joined at their sides by cross ridges which make an irregular network with meshes; and in these meshes may be seen with a lens a number of minute openings which we will call "pores," making the meshes look rather like a sieve. These pores open into a space beneath the skin, and from this space the inward channels spread into the substance of the Sponge. Thus the Sponge consists of a fleshy mass, supported by a network of elastic fibres, invested with a skin and traversed by two sets of canals; the outward, each opening by a single little mouth to the exterior, and the inward, which communicate with the exterior by these sieve-like groups of holes. Dr. Robert Grant, of Edinburgh, about 1827, was the first to discover a constant flow of water with floating particles of food into the pores, and inward channels, and out of the outward channels, and little mouths. He rightly conjectured that this stream of water constantly flowing in and out, must be due to ciliary action, but he was unable to find the cilia; they were subsequently found by Dobie, Bowerbank, and Carter. We will now turn our attention to the small cells which have the cilia or lashes. Scattered all over the Sponge are little chambers about $\frac{1}{1000}$ in. in diameter, which are lined with micros-

copic cells each having one lash. The cells are arranged in one layer on the walls of the chamber, and rapidly lashing the water in one direction, they are the cause of this constant stream of water. The inward channel terminates on one side of these chambers, and the outward channels begin on the other side, so the water is sucked in at the pores and driven out violently at the little mouths. The entering currents contain minute particles of food, and also Oxygen in solution, the outward stream contains Carbonic Acid and compounds of Nitrogen and Carbon and Hydrogen, such as are formed by all living animals. The cells will bear a still closer examination, they consist of a spherical body of protoplasm, granular within but firmer and clearer outside, containing a nucleus, and one or more contractile vesicles; one end rests against the wall of the chamber, and the other, the free end, is prolonged into its cavity with a long clear neck; around the margin of the free end there is an extremely thin collar, and from its centre a long slender lash protrudes. The collar is a soft semi-liquid material which is constantly circulating, streaming up on the outside and down on the inside, like an endless band in machinery. Particles of food drawn to it by the lashing movement are carried up the outside and down the inside, till they reach the base, where they enter the substance of the cell; a little drop of water is included with them, and thus the cells not only eat but drink; the constant circulation of the collar exposes a continual change of surface to the water by which Oxygen is absorbed, and so the cell breathes.

The tissues of a sponge consist of three layers, an outer, middle, and inner layer of cells. The outer consists of flattened cells with many angles, which cover the whole outside of the Sponge, and line the inward channel. The inner layer lines all the outward channels and the lash chambers, and is of the same nature as the outer layer, except in the lash chambers, where, as we have seen already, it consist of the remarkable lash cells. The middle layer is a sort of jelly with stellate angular bodies in it. The skeleton, which we have here, is formed by the cells of the middle layer, and it consists of a network of fibres of spongin, which both chemically and microscopically resemble silk, both substances being regarded as horny matter by chemists.

The eggs of the Sponge are also found in the middle layer. They are round cells with a large nucleus and nucleolus. In development these eggs divide first into 2 cells, then 4, then 8, and so on until a globular cluster of similar cells is formed called a morula, from its resemblance to a mulberry. The outer cells now develope cilia or lashes; and in this state the young sponge generally escapes into one of the outward channels, and is washed away into the

surrounding water where, after swimming about free for some time, it finally settles down on some substance and loses its cilia, and begins to lead a quiet immovable and undisturbed life on its own account.

Sponges vary greatly in form and size from a pin's head to 5 or 6ft. high. Some shapes are constant and characteristic, as the fairy-like Venus Flower Basket, *Euplectella*, the glass-rope Sponge with its cylindrical body, *Hyalonema*, the open Flower Basket Sponge, *Dactylocalyx* and the Great Neptune's Drinking Cup, *Poterion*; but usually the shape is variable in the same species as we have mentioned is the case with the Bath Sponge.

The *character* of the skeleton is wonderfully diverse if we consider the whole family of sponges, but in opposition to the *form*, is tolerably constant in the same species, and it is therefore taken as the basis for classification. Some sponges have no firm skeleton; they are mere jelly-fish amongst Sponges, and are called Soft Sponges. In some, the skeleton consists of chalk spicules or needles of different shapes. In some of flint spicules, and in some of a network of horny fibres with no proper spicules. These then are the four great divisions of Sponges. The different spicules are beautiful objects for study with the Microscope. The members of the class with flint spicules are the most numerous, diverse and complicated. They are spread through all seas, at all depths, and all ages, being found as fossils as early as the Cambrian system. Amongst the species belonging to this class, is found the lovely object whose skeleton is known as Venus, Flower Basket. *Euplectella*, meaning a little thing beautifully woven. It has a framework so exquisitely beautiful in its fairy-like tracery as to have called forth the remark from a distinguished naturalist "this passes the love of woman." Its spicules are so arranged crossing one another as to weave together a thin walled vase of delicate, very regular lattice work, with oblong meshes. The longitudinal lines of the skeleton, and the transverse are remarkably regular, the diagonal which are applied on the surface of the others, so that they seem to stand out from them like delicate muslin folds, are so arranged that every alternate mesh is left clear, whilst the others are covered by them. At the base are an immense number of silken glassy hairs, which envelope it almost completely. The lid is of quite a different style of architecture, being an irregular network of stout fibres, and containing none of the microscopic fibres that are so abundant in the body of the vase. The lash chambers exist in the wall; they are like cylinders, with a large opening at one end, and perforated by pores, through which the water is drawn by the lashes, and driven into the interior of the vase, whence it escapes partly by the alternate open meshes in

the side of the vase, which are the "little mouths" in this creature, partly by the holes in the netted lid at the end. The skeleton terminates below in a tuft of spicules by which it is anchored.

Another group of Sponges, the Horny division contains all the kinds used for commercial and domestic purposes as they are free from spicules. These sponges of commerce come from the Eastern Mediterranean Sea and the West Indies. In the Archipelago, Crete, Cyprus, on the coasts of Asia Minor, Syria, Barbary, and the Bahama Islands of the West Indies, sponge fisheries constitute a very important industry. The finest sponges are contained in Turkish waters The fishing season commences in May, and closes in September or October, Diving is practised and is carried on in a rude, primitive manner. The diver, who has no dress, seizes hold of a large stone, to which a line is attached, and sinks by means of it to a depth varying from 30 to 180 feet. Keeping hold of the rope, he tears the sponge off the rocks within his reach, and places it in a net; when he has secured a netful, he signals by means of the rope to be drawn up. A diver usually remains under water from 40-60 seconds. Formerly all the sponges gathered in the Archipelago were sent to Smyrna for transhipment to England and the continent, but now many cases of sponge are shipped direct from the islands themselves. The exports in 1876 from Rhodes and the Sporades amounted in value to £140,000; from the Cyclades £21,340 and from Smyrna £204,433. The fisheries of Cyprus in 1877, yielded 7000lbs. weight of sponges, and the exports from Beyrout in the same year were valued at £8000 sterling. Sponge of a coarse texture and large honeycombing is found all along the coast of Tripoli and Tunis. The total exports from the regency of Tunis in 1875 were valued at nearly £11,000. The value of sponges exported from Bengazi, Tripoli, amounted in 1876 to £55,000. The West Indian trade is annually increasing, and the fishing industry gives employment to 500 vessels and 2,000 persons. The Bahamas and the coast of Florida are the fishing grounds, and Cuba will probably soon join them. In this part of the world, the sponges are obtained by spearing with a pronged fork fixed to a long pole. In 1877, nearly 3,000 cwts. of sponge were exported to New York, Canada, and England, from the Bahamas. Wool, glove, grass, and yellow sponge are all shown on the table, with other varieties.

To turn again to Euplectella for a few moments. Many years ago, when Paley wrote his "Evidences of Christianity" one of the strong arguments used by him to prove the existence of a Creator, an all-wise Supreme Being was Teleology, or the doctrine of Design as shown in the works of nature. Since the appearance of the Origin of Species by Darwin, 27 years ago, scientific men have been

inclined to teach that all that is marvellous, all that is beautiful in this wonderful world of ours is simply the effect of what we may call the unguided forces of nature. Now, I believe that all must, and will allow that variations in living beings which benefit the owner are likely to be perpetuated, and that the fittest for the battle of life are likely to survive, and that in this way many wonderful changes in the descendants of animals and plants may be accounted for ; but these laws do not reach far enough to explain away what I believe is a self-evident fact—that such a wonderful skeleton as that, is evidence of design, and of a guiding Hand, and that Hand belonging to one Almighty and all-wise. It is so important now-a-days to have some firm basis, for even the most elementary of Theological beliefs, viz., that there is an Almighty and all-wise Creator, that I do beg of you when observing these beautiful natural objects so marvellously adapted to their purposes, to think a little deeper, and recognise that chance variations perpetuated by their helpfulness to the owner, will not, cannot, displace the evidence of design as seen even in such a humble organism as this beautiful sponge, Euplectella, or Venus Flower Basket.

The paper was well illustrated by diagrams and microscopic preparations. A good collection of modern and fossil sponges was also on the table.

December 14th, 1886.

There was a good attendance of members in the Council Chamber, the President in the chair, and the Secretary read the following paper on

DEGRADED FORMS OF ANIMAL LIFE.

I have no doubt most of my audience are familiar with Charles Kingsley's "Water Babies," and that they remember, recorded therein, "The History of the Great and Famous Nation of the Doasyoulikes," who through their refusal to perform the part allotted to them in Nature, gradually lost all their endowments as human beings, and sank from bad to worse, until their last surviving descendant was shot by Paul du Chaillu in the African forest—a sad but instructive example of Degeneration, a history full of truth, as all Kingsley's writings are.

For, whether we study the histories of ancient and modern empires, or whether we interest ourselves in the life histories of our

fellow creatures, we cannot help seeing that degeneration has full play in the world as well as upward development. Empires, nations, societies, brotherhoods, and individuals—all are subject to the action of both forces. On the one hand the nation that is conscious of its opportunities, and makes use of its God-given advantages to do the duty that lies nearest to it, surely has "Excelsior" inscribed upon its banners, surely presses onward and upward to its full stature, to a high dignity among its compeers; but on the other, so surely as it neglects these advantages, and yields itself to *laissez-faire* or worse, and most surely of all, if it ceases to depend on its own exertions, and in selfish isolation worships the god of non-intervention, or, it may be, tries to live by and on the efforts of others, it sinks lower and lower, till it loses the semblance of a nation altogether.

So too, with the individual. He who, born to high opportunities and entrusted with many talents, throws them aside, one after another, because the effort to use them is too great for his indolent soul, falls from one stage to another in society, becoming at last a mere dependent—a parasite—a failure.

If inclined to do so we might well confine our attention this evening to degraded forms of human life—national, or social, or individual. We might draw our examples from many sets of people who seem to have missed their way in the world. It has, as you know, been frequently a subject of dispute about savage tribes—whether they have sunk down from an originally high condition to their present state or whether they represent now what the whole human race was once, and have failed to rise like others have. Both opinions are probably true. It is a curious fact bearing on this point that the most degraded human tribes are to be found inhabiting the extremities of continents, both in the Old and New Worlds, as if they had been edged out, as it were, from society, *e.g.*, the Patagonians and Esquimaux, the Australians, Tasmanians, and Samoyedes. Concerning such the Duke of Argyll says: "We should be safe in assuming them to represent the widest departure from that earliest condition of our race, which, on the theory of Development, must of necessity have been associated at first with the most highly favourable conditions of external nature." We must look upon the Eskimo, according to Max Muller "either as a withering offshoot of the American mound-builders or as a weak descendant of Siberian nomads." There are progressive and retrogressive savages, developing and degenerating tribes, though the latter appear to predominate.

And it must be so. We are subject to the same surroundings, influences, and circumstances as other creatures, and though we have a power within us by means of which we can rise superior to

circumstances, and even control them, yet as often as not man fails to use that power and sinks in consequence, the prey of circumstances.

There is hardly a phase in human society that has not its counterpart in the social economy of the animal world, and it would form by no means an uninteresting subject if one of our members would take up these analogies and work them out. It is always easier, and perhaps pleasanter, to trace out the faults of others than to detect them in ourselves; so let us turn our attention to the question of degradation among other forms of life.

It is often taken for granted by those who dabble in Darwinism, that development is always in an upward direction. A very slight acquaintance with the ordinary facts of Nature would serve to dissipate this delusion. It has even been said that it is highly improbable that man, or any set of men, should lose any art of civilization when once the value of it is known; and that it is not likely that any structure of advantage to an animal should ever disappear. There is no improbability in either case; it has frequently happened. In the working out of the close relations which connect the animal creation with its immediate surroundings, there are (as a great authority would say) three courses open, either of which may be adopted. There may be an upward development (such as has taken place in European nations generally); there may be a standing still, a state of balance (illustrated by the Chinese); or there may be degeneration (as with the Egyptians and Turks). With man it almost wholly depends upon himself as to which of these shall be his fate; but we cannot say the same of the lower animals, which are, so much more than ourselves, the creatures of circumstances. We are to confine our attention this evening to the last condition only, and it will perhaps be as well, before proceeding further, to ask the question—What is degeneration? When are we justified in regarding an animal as having fallen from its high estate? What are the outward and visible signs? Is an animal which passes its life rooted down in one place, (*e.g.* a sponge) necessarily a degraded form? Are parasites all or any of them, degenerated animals? How are we to know?

We can only tell by ascertaining, as far as possible, what each particular species was intended to be, and whether it has fulfilled its destiny. This is treading, I know, on delicate ground, perhaps questioning design, implying possible failure; but here it is for discussion. How can we tell what any particular form was intended to be? We may do so, I think by finding out, so far as we can, from its early stages and the general character of its confreres, what it might have been. We regard a man as degraded when we know from his early circumstances that he could

have been something far higher, far nobler, than he is. We look upon such countries as Spain and Turkey as degenerated, because they once had grand opportunities of developing themselves. So we may study forms most nearly related to any species of animals, those which had the same start in life; and see what they have developed into; and then try to discover whether this special form might not have done something similar, and why it has failed.

There are, as every one must acknowledge, animals in the world occupying positions, and performing functions which we shrink from, believing they were specially created to occupy and to perform—I mean such examples as Parasites, and especially those known as Entozoa, which prey on the internal organs of creatures infinitely higher than themselves, whose life may be a prolonged agony through the necessities of their existence. As I hope to show you presently, we have every possible reason for concluding that they are not in their proper places in the world; that many of them started in a higher condition, came into existence with opportunities, of which they have failed (we know not how or why), to take advantage, and so they have gone wrong. There has been a physical fall among these animals, just as there has been a moral fall in man.

It would be a great scientific heresy if we were to suggest spontaneous generation. I, for one, am not going to do so, as I do not for one moment believe in it; but it would do away with a few serious mental difficulties. And if I am putting a few of these forward tentatively, it is in the real hope of getting them discussed. We are told now by very high authorities that many diseases are brought about by actual living organisms—bacteria, bacilli, &c. Now how and why were these organisms created? Where did the first bacillus, say of splenic fever, come from? Was it an accidental or intentional production? Are we to regard these microbes as retrogressive forms, or as potentially progressive? Of what benefit are they? To call them specially into existence as they are—and they must have had a beginning, however they may be propagated now—would seem to be the creation of a positively Evil Thing. One can hardly wonder that the untutored mind of earlier times, looking (not upon these, it is true, but) upon similar things, regarded them as proofs of the existence of two creators, one of good, the other of evil things—Ormuzd and Ahriman. But if there were such a process as spontaneous generation, there would be less difficulty in seeing how occasionally an inconvenient thing might be developed. Here is perhaps another point for your discussion.

What then are the degenerate forms? Well, I should say that if an animal started in life specially provided with suitable limbs, and such useful organs as eyes and mouth; and after a time lost them

all and passed into a kind of vegetative existence—that might be justifiably regarded as degradation. If it commenced existence with the special and peculiar endowments of a vertebrated animal, and ended in being a mere animated bag of seawater, it would be a degraded animal. If it emerged from the egg a freely moving creature, swimming hither and thither, and earning its own living, and then finished up by burrowing into the tissues of a higher animal and feeding on them, it would have degenerated. In fact, whenever an animal loses its higher endowments, parting with specially organised limbs or senses, and so seems to have fallen, not merely as an individual in a class, but to have actually sunk into a lower class—there cannot be much question about it. The frog commences life as a fish, but developes into something higher than that. How should we regard it if it began as a frog, and ended as a fish? Other creatures start very similarly with a tadpole stage, but end on a far lower step of the ladder of life. Again, the rats, the lizards, fishes, and insects in caves, possessing but mere rudiments of eyes, or none at all, are undoubtedly the descendants of rats, lizards, fishes, and insects, which possessed fully developed eyes; surely they illustrate degeneration. And this degeneration you will notice is sometimes, as with these cave animals, a degeneration of the whole species or even genus, and extends through the whole career of the individual; in other instances which, I shall first illustrate, the gradual descent is traceable in the life of each individual.

We will take as our first example an animal that occupies a very prominent place in all works on development, common on some shores, but slighted and passed over by ordinary persons as a thing of no beauty, and to which no interest could be attached. I mean the Ascidians, a tribe of tunicate Molluscs, possessing characters at one period of their life, so peculiar, that some biologists claim them for the vertebrate kingdom. In the Darwinian Theory they are most important, since the author himself tells us we are justified in believing that man is descended from a tadpole-like form closely resembling that of our present Ascidians.

In outward appearance the Ascidian or Sea Squirt is a rough leathery bag, like a two necked bottle, found fixed on rocks at low water mark. We naturally look upon it as a "low" form of life because it is a fixture, and seems to have no relations with the outer world beyond the satisfying of its hunger with what may chance to flow into its mouth. Yet we are told by naturalists, that it alone, amongst all invertebrate creatures, possesses in early life the four marks which characterize especially the members of the vertebrate kingdom, whilst the action of its heart in propelling the blood alternately to the body and to the aerating apparatus, is

absolutely unique. "These four great structural features are, first the primitive backbone or notochord; second the throat perforated by gill slits; third, the tubular nerve centre or spinal chord and brain, placed along the back; and lastly, and perhaps most distinctive and clinching as an evidence of affinity, the myelonic or cerebral eye." (Ray Lankester).

Without going into detail concerning these four organs, I may yet draw your attention to one or two points in its structure. Its outward appearance is well shown here, and we have also a diagrammatic representation of its internal arrangements. The upper aperture or mouth leads into a cavity or chamber of considerable size, the walls of which are a close network of blood-vessels, full of perforations or meshes opening into a second cavity which communicates freely outwards, by the lower, or atrial opening. A constant stream of water flows in at the mouth, through these meshes, and out by the atrium, exactly as water passes into the mouth of a fish, and out by the gill openings. And for the very same purpose, the network answering to the gills of the fish, *i.e.*, effecting the purification of the blood. The food which enters with the water passes downwards into the alimentary canal, which likewise opens into the atrium. Thus we see, there are mysteries wrapped up even in this leathery Sea Squirt, and processes are at work in it exactly corresponding to those in our own system, proclaiming a common kinship. But now, this fixed and rooted organism, which has just about as much relation to the world outside itself as that which formerly characterized the Chinese nation, produces eggs which give rise to a creature totally unlike the parent,—a creature which occupies a place in the animal kingdom higher than the mature Ascidian, and which, as I have to show you, has actually to degenerate in its structure by two or three stages until it sinks into maturity. Soon after emerging from the egg the infant Squirt has a tadpole form; notice its resemblance to that of the frog, though of course the latter is much larger. There is the mouth, there is one eye, only one, but that is more than its parent had; there is a nervous system prolonged behind, and in the tail the structure known as the notochord, which occurs otherwise only in vertebrated animals. With them as with this, it occurs only in an early embryonic stage, but is soon replaced by a true spinal column. This larva is a free swimming creature, actively roaming about and seeking its own food. Having within it those four elements of development into the same division as that which we ourselves occupy, how is it that it fails to rise beyond one or two steps? How is it that it developes upwards to a certain point, and then commences a downward career? Degradation it undoubtedly is, for it loses the solitary organ of sight,

attaches itself permanently, head first to a rock; its tail is gradually absorbed, and with it the notochord disappears, while the nervous system dwindle down to a solitary ganglion between the mouth and the atrium, which distributes branches to the other parts of the system, and cannot, even by courtesy, be called a brain. Further than that, the outer coat actually becomes of a vegetable nature, developing cellulose, a special characteristic of plant tissues. (Stages shown by the diagrams). We have, represented here, as it might be, the life history of a man, born with all the advantages of birth, riches, and refining associations, losing them one after another, and, withdrawing from society with all its civilizing influences, becoming at last the companion of savages,—himself a savage.

Of course one would not hastily conclude that all animals which pass a free existence at first, and then become fixed are degraded forms. The main point that decides it is the early possession of organs belonging to higher creatures, and the ultimate and inevitable loss of them.

My second illustration is that of the Barnacle (*Lepas anatifera*) found so frequently attached by long semi-animal stalks to floating masses of wood. Who by the mere study of its ordinary form would set it down as a near relation of crabs, lobsters, and shrimps? What has it in common with them? What grounds have we for classing it as a Crustacean, instead of a Mollusc, as former zoologists did? Only its early history, only the curious character of its development. It begins life in a form only just below that of a crab, and similiar to that of a cyclops, or a water flea, both of which pass it by in development. Let me direct your attention for a moment to these curious larval forms of Crustaceans. We have here represented those of the Cyclops, a Shrimp (*Penæus*), the Barnacle, and a Sacculina, which latter as we shall presently see, is still more degraded than the barnacle. They are all well provided with organs of locomotion, and spend a very active youth. So utterly unlike the parent form are they that they were long regarded as distinct creatures, and were known by the generic name *Nauplius*, which they still retain. The Shrimp and the Cyclops pass through higher and higher stages, losing none of their earlier advantages, and gaining many additional ones. But this Barnacle Nauplius, not the least graceful of them all, after several moultings like those of a caterpillar, during which it loses its mouth, and then occupies its time as a bivolve, seeking a suitable spot on which to vegetate, attaches itself first by a sucker and at last by its head (diagram) to a block of wood with cement of its own manufacture, loses its highly organized compound eyes, being completely sightless for the rest of its life, and changes six pairs

of swimming feet into feathery plumes, which now wave around a new aperture which serves as a mouth. It began life, I say, on the same footing as a shrimp, but the latter passed it in the race, and we can with difficulty recognise it as a member of the same order.

There does not seem room for doubting that the Hermit Crab occupies a niche in Nature's temple not destined for him. At some former period one might imagine that his indolent ancestors, in order to protect themselves better, "hit on the happy device of utilizing the habitations of the molluscs which lay around them in plenty, well built, and ready for immediate occupation" (Drummond). Ceasing to care for its own protection, it has gradually lost what was given it for that purpose, and its shell and some important organs have altogether or well-nigh disappeared. The Hermit Crabs are like men who have ceased to construct houses using instead the caves in the rocks. "To the eye of Science," says Mr. Drummond, "its sin is written in the plainest characters on its own organization."

But now, this degenerate member of crab society harbours in his own tissues a still more degenerate crustacean, whose downfall has been thorough and complete. The representation of *Sacculina* (diagram) would not be taken, I venture to say, by any non-naturalist as that of an animal at all. It is in fact a mere membranous bag with no organs of sense whatever, full of eggs, and having this bunch of tortuous organs, by means of which, as with roots, it burrows into the tissues of its host. "It possesses neither legs, nor eyes, nor mouth, nor throat, nor stomach; . . . it is a typical parasite. When we enquire into the life history of this small creature, we unearth a career of degenerency all but unparalleled in Nature" (Drummond). For it begins life, as we have said, as a Nauplius, in a form little below that of its host, but at a certain stage in its history it shrinks from the struggle of life, and forces others to provide for it.

There are certain people who sometimes talk glibly of what they call the Laws and arrangements of Nature, and say that we cannot do better than imitate them—people who say society ought to be constituted like that of bees or ants—people who would degrade the dearest relations of life to such as exist among the lower animals. I wonder if they are conscious of the results which would ensue, if their ideas were consistently acted upon. There is never a crime that man committed, which might not be justified by examples from nature. Theft, robbery, slavery, war, murder—we can see them all going on around us daily in the "arrangements" of the animal kingdom. The human parasite might readily justify his unjustifiable meanness, if we allowed him

to shelter himself under the example of nature. One thing we can do, we can appeal to her to warn him of the dire consequences of parasitism, of which crime she is a stern and invariable Punisher. She deprives the bats and insects of eyes if they shun the light of day, and retreat into the darkness of caves; and similarly she has deprived the Hermit Crab of his shell and one of his claws and the Sacculina of well-nigh everything it once possessed. The diagram shows you its capabilities in its youth; it comes from the egg endowed with three pairs of swimming organs; as it moults it becomes enclosed in a thin bivalve test or shell; then by means of the hooks which have now appeared on its front limbs it fixes itself on some unfortunate hermit who happens to be changing his habitation; "the sight of means to do ill deeds makes (another) ill deed done," after which the Sacculina subsides into quiescence. "Corpulent, blind, legless cripples, their existence is more precarious than that of the most miserable, mutilated beings found in our cities, they only live on the blood of the neighbour which gives them an asylum. Yet when they first quit the egg they are all free; they frisk, they swim with the rapidity of lightning, and at the close of life we find them deformed, and crouched in some living refuge, as if a foul leprosy had atrophied within them all the organs which served as a means of communication with the outer world." (Van Beneden).

In the previous instances we note that the degeneration attaches to the latter stages only of the animal's existence. We might almost imagine, I do not know why we should not, that there is still for each of them a possibility of regaining the lost ground, still a chance for an upward movement in the battle of life, seeing that the early stage is already a high one. There are other Parasites, however, the degradation of which is far more thorough and complete, since it is patent throughout the creature's whole existence. It is born a parasite, and it remains one till death. Like a nation utterly irreclaimable and depraved, in which there is no tendency or opportunity, not even the desire, in any one individual, to reach up after better things. It is a degeneration of the whole kind, species, or it may be genus. Hatched from the egg in the body of a higher animal, it takes up its abode there permanently, or it passes by a strange transmigration into the body of another, higher still, maybe even into our own, and perfects itself there. I am thinking especially of the internal parasites, the *Entozoa*, whose life histories are as marvellous as any of those I have related. The suitability of their organization for their functions is as complete as our own Without organs of sense or digestion, none of which are needed, they are well supplied with those of prehension, in the form of suckers and hooks, by means of which they attach

themselves to their hosts, whose tissues they waste away with suffering and disease. It is with reference to these creatures that the argument from design is scarcely applicable, except from the creature's own point of view, it being, as I said, well adapted for its vicious career. We shrink from saying, even with such an authority as Van Beneden, that "all these mutual adaptations are pre-arranged." No one can have his attention drawn to them without asking involuntarily, Why were they created? How came they, part and parcel as they are of evil things, into existence at all? By no answer that I am acquainted with can the difficulties be completely cleared away; but they are not so insuperable when viewed in the light of the Development Theory. I shall not forget the relief that came to my mind when I found it possible to regard them (as I find all great authorities regard them) as creatures that have missed their way in the world; that were started with good opportunities and advantages, but somehow or other have gone off the right track. It is much easier to believe this than that they were designed for the work they are now doing.

If you ask me how or why they got off the track, how or why they missed their way, I have no reply. The existence of physical evil is a greater mystery to me than that of moral evil. The difficulties of the two run to a certain extent in parallel lines. To a certain extent only, for we can easily see how moral evil might come in connection with a being possessing a free will to choose his own path; but it is not so with physical evil and the lower animals. For the solution of problems like these we must be content to work and wait.

In the short discussion which followed,

The President took exception to the statement that nations might lose any arts of civilization which had once been found advantageous.

Mr. Walton believed man to have been originally highly endowed, and that he had gradually degenerated in the case of savages. That possibly there had been a pre-Adamite race, which had become extinct before the appearance of the Biblical man.

Referring to the early free-moving condition of many animals which are fixed in their adult stage, he thought that it was an arrangement for ensuring their dispersion.

Dr. T. Eastes in reference to bacilli, &c., said they seemed to be agents appointed to clear away dead hurtful matter, being always present in putrefaction; and that when found in man, as in certain diseases, they had, like some of the creatures mentioned by the lecturer, missed their vocation.

Annual Meeting—January 25th, 1887.

The annual meeting of the members of this society was held at the Town Hall. on Tuesday evening, Dr. Fitz-Gerald presiding. There were also present Dr. T. Eastes, the Rev. A. L. Hussey, the Rev. W. Hall, and Messrs. Walton, Knight, H. Ullyett, Hon. Sec., A. H. Ullyett, and others, together with a good number of lady members.

The President lent a number of very interesting photographs, among them being a portrait of Rameses II. (Pharaoh, the oppressor of the Israelites in Egypt), taken from his mummy recently discovered. The business commenced with the reading of the Secretary's Report as follows:—

"I am happy in being able on this our 19th annual meeting to congratulate the Society on its continued prosperity and success; the number of members during the past year has been 106, and all the meetings have been well attended. Our balance sheet leaves us just solvent, and we have a reserve fund of £20 in the bank. That sum, as you are aware, was given by one of our members on her leaving Folkestone—Mrs. Rumsey, a lady whose face was familiar at all our meetings, and who evinced great interest in our work. This, the first donation, we have received, will it is hoped, be followed by others, in which case the scope of the Society's work may be very much enlarged. I regret to say that two of our members have been removed by death—Mr. Arthur H. Taylor, who was an ardent naturalist, and Mr. J. W. Roberts, of Cheriton Gardens. During the year 1886 we have held eight meetings, one of which was on the Warren. The following papers have been read:—

The President's Address at the annual meeting in January.

Darwin and his opinions, by Mr. Smurthwaite.

Man and his relation to the lower animals, by the Rev. J. R. Duke, M.A.

The theory of Malthus in relation to Darwinism, by the Secretary.

Common objects of our shore, by Mr. Walton.

The Colour of Leaves, by Mr. Gorham, of Tonbridge.

Sponges, by Dr. T. Eastes.

Degraded Forms of Animal Life, by the Secretary.

Very fair discussions have followed some of these papers. The approaching completion of the new building on Grace Hill, where the library, reading room, museum, and science classes will all be sheltered under one roof, is the realization of a dream, in which some of us have indulged for several years. I think nothing redounds so much to the honour of the ratepayers of Folkestone as the fact that they themselves demanded this building to be erected, and that at their own expense. Let us hope that a school

of art will soon be added. Our Committee under whose care the Museum has been ever since its opening, 17 years ago, have addressed a memorial to the Town Council, renewing the offer they made then, to superintend the classification, and labelling of the specimens on their removal. We hope that this will be accepted, since it is highly important that such arrangements should be carried out under one sole authority, and that that authority should be one thoroughly conversant with natural history. We do not want our Museum to be a collection of curiosities, but a centre of education, and a representation of what our own district produces. The work of our Society would not in any way trench upon the duties of the Museum Committee of the Town Council which has always co-existed with our own.

We are in correspondence with the following Societies, with which we exchange copies of the proceedings.

Tunbridge Wells Natural History Society.
Huddersfield Naturalists' Society.
East Kent Natural History Society.
Brighton and Sussex Natural History Society.
Eastbourne Natural History Society.
Harrogate Natural and Scientific Society.
Philadelphia, Academy of Science.
New York Academy of Science.
Imperial German Academy, Halle on the Saale.

Copies of these proceedings can be seen on application to the Secretary.

PRESIDENT'S ADDRESS.

Dr. Fitz-Gerald then gave his annual address as follows:—

This is an age of averages; of average excellence if you will, but nevertheless emphatically a level, average age. This is the inevitable result of the levelling-up tendency caused by the increase of technical education, spread of scientific thought, and general evolution of intellect. Look around on the world; everywhere is seen the same dead level of uniform intelligence; an extra inch of intellectual stature makes a man respectably eminent. Nowhere do we see the heroes of a former age; no being of colossal intellect towers far above his puny fellow-men. Where shall we find the Newtons, the Galileos, the Herschels of the past? No Milton, no Shakespeare, no Dante or Goethe moves our feelings or charms our ear; no Titians, Vandyke, or Rembrandt delights our eye; no Frederick the Great, no Napoleon, alternately rouses the terrors and admiration of a hemisphere; no Macready stirs our inmost feelings on the stage; no Burke or Pitt keeps a wondering world spell-

bound by his burning eloquence. Philosophers, poets, painters, generals, and actors we have by the hundred, all excellent, all celebrated, but not the intellectual giants of a by-gone day.

The same monotony has now reigned for some years in the scientific world. Past are the days when mankind was awakened and regenerated by such startling inventions as the steam engine and the electric telegraph. Not long ago we had quite a crop of new inventions, such as the telephone, the microphone, and the phonograph; but these were rather novel applications of well-known principles, than really new discoveries, and had been fostered into rapid growth by the warm breath of popular encouragement, and the munificent favour now extended to practical science. The world has at last awakened to the commercial value of scientific attainments, and scientists can no longer complain of any lack of appreciation or reward. But although during the past year science has taken none of the gigantic leaps or bounds which from time to time startle the world, there has been no dearth of the intellectual work now so universally carried on, at the highest pressure, by numberless workers. Experiments, observations, and calculations are being incessantly made, re-made and verified; one day, doubtless, to be worked up by some master mind into inventions which will again electrify mankind.

Scientific photography especially has made great advances, for, wonderful as it sounds, photographic plates are now rendered so sensitive as to record impressions imperceptible to the human eye; and experts are enabled to perform the apparently impossible feat of photographing the invisible. A curious instance of this has been recorded in which a child, with an apparently clear complexion, was photographed, and the negative showed plainly a number of spots on the face. In ten days afterwards these spots were visible on the child's face as an eruption of small-pox. The same thing was also observed in the case of a child with measles. Messrs. Henry, of the Paris Observatory, have been doing good work there with the large new photographic apparatus, and have succeeded in photographing the group of stars called the Pleiades, showing no less than 1421 distinct stars, as well as a spiral nebula never before seen. Absolutely correct photographic maps of the heavens can now be produced showing hundreds of thousands of stars only perceptible with the most powerful instruments, and many others literally invisible to the human eye. Admiral Monchez says in his report: "Astronomers will now be able to leave to their successors not merely fanciful drawings, but the absolute position in the sky of between 20 and 30 millions of stars" The observations taken during the total eclipse of the 29th August last, which was carefully watched from the West Indies, have not apparently done

much towards settling the difficult question of the nature of the corona and red flames and prominences which seem to surround the body of the sun during a total eclipse. Of course the same absorbing interest is not felt in solar eclipses since Mr. Huggins discovered his ingenious device for taking spectroscopic observations of the Corona, etc., without the aid of a total eclipse—in fact at any time when the atmosphere is clear. Thus the sun has been photographed 205 times during the year in England, and by interlopating the pictures obtained in India, the number is made up to 360.

We all know the corona is the pale pinkish-white light seen during a total eclipse to surround the body of the sun to a distance of some 10 millions ot miles. The whole globe of the sun is also known to be enveloped to a breadth of 50,000 miles, in an atmosphere of lambent glowing flames of incandescent hydrogen, through which red fountain-like jets of flame are seen to shoot to distances relatively short, but sometimes reaching a height of 300,000 miles. These red jets are now found to occur only on that portion of the sun's disc which corresponds to our sub-tropical zones, and on which alone sun spots are ever seen; hence it is called the sun-spot zone. Mr. Proctor has a new and most fascinating theory as to these sun-spots (many of them large enough to swallow up thousands of our worlds) and the jets seen on the same zone. He considers them as evidence of stupendous volcanic action in the sun, during which these red jets of denser material are shot out from his surface with a velocity of some 350 to 500 miles a second, sufficient, he calculates, to carry them beyond the influence of the sun's attraction into spcce, where they are now revolving in some other stellar system as meteoric bodies. We pass through a thick belt of such meteors each November, not to mention the millions of shooting stars we encounter at other times. It is, of course, the friction caused by the rapid transit through our atmosphere which ignites them and causes them to glow with such brilliancy. All the other suns which people space are probably, like our own, in a state of violent volcanic activity and shooting forth solid matter from their interiors, and Mr. Proctor believes this to be the source of the countless myriads of meteors which throng our own and other planetary systems. While speaking of the sun, I may mention that the glowing atmosphere (if it can be so called) surrounding this globe having been found to consist mainly of incandescent hydrogen, lends great force to Mr. Norman Lockyer's theory, that all the so-called elementary bodies are capable (under certain given conditions of pressure and temperature) of being resolved into what he believes to be the one and only really elementary body, hydrogen.

The volcanic energy of our globe has certainly shown no diminution during the past year, for it has not only been exercised on a grand and devastating scale, but over an enormous area, the earthquakes in Greece, America, and New Zealand being especially marked with disastrous consequences. It would almost seem as though earthquakes were becoming more and more frequent in late years, although this appearance is no doubt partly due to the ever-increasing number of scientific observers and to the delicacy of the seismological instruments now used to record the slightest tremor of the earth's crust. At present we take in this country only a languid interest in foreign earthquakes, because we lie out of the immediate tract of the recent volcanic disturbances; but we must not forget that the British Isles have been in former ages the scene of tremendous convulsions of nature, and the shocks recently felt in the Hebrides and in Norfolk remind us disagreeably that our turn may possibly come again. It would fare badly with London and most of our large towns if a shock of earthquake occurred, the tall modern stuccoed mansions, built of bogus bricks, rotten mortar, and flimsy joists would collapse like a pack of card houses. Fortunately, however, London is built on a stratum of clay or gravel, both of which are bad conductors of earth tremors.

It really seems at last that the day may not be far distant when people, instead of making the invariable comment on the present state of the weather, may discuss the probabilities of the morrow or the chances of storm or sunshine for the next week. There is no doubt that meteorology is becoming year by year more a precise science, and the numerous and complex laws which govern it better understood. Mr. Eddy, of the American Signal Service, reports that of 38 predictions issued in April to June, 1885, 18 proved correct; but during a similar period in 1886, 15 out of 19 storm prognostications were absolutely true, while in the remaining four, hailstorms and wind prevailed.

Two of the urgent necessities of mankind are pure water and available heat. The teaching of last year leads us to the conclusion that both these essentials can be obtained in inexhaustible quantities by scientifically "tapping" the supplies which exist beneath the surface of the earth. The investigations of Mr. de Rance prove that the water-bearing strata of England absorb from one to twelve inches of rain water annually, and that every inch is equal to a supply of 40,000 gallons daily to every square mile. This would give a daily underground flow of from 40,000 to 480,000 gallons to each square mile, more than sufficient for all the wants of the population. To utilise this enormous supply wells must be sunk in water-bearing strata only, and with scientific precision. Underground water, being naturally filtered, is un-

doubtedly purer and more wholesome for drinking purposes than the always more or less contaminated waters of surface springs, rivers or lakes.

We hear a good deal about our coal supplies becoming exhausted, so it is consoling to hear from America that the coalfields of that country alone are sufficient to supply the whole world for some 2000 years longer. No doubt the apparently inexhaustible supplies of petroleum recently discovered in Russia, and which are brought through wooden pipes some 500 miles to the seaboard, will furnish a cheap substitute for solid fuel in the immediate future. Petroleum has been recently used, not only for smelting operations, but as a substitute for steam in propelling vessels. These ships have neither paddle-wheels nor screw, but carry a large tank containing petroleum, which is conducted in small charges along a steel pipe which opens in the stern of the vessel just below the water-mark. It is here mixed with atmospheric air to render it explosive, and each charge is fired in quick succession by electricity. The force of the explosion being expended on the water astern is sufficient to propel the vessel at the required speed. A practical step in the direction of utilising the internal heat of the earth has been made at Pesth, where a well has been sunk to 3,000 or 4,000 feet in depth and water raised at 180 degrees of heat, a temperature at which most culinary operations can be conducted. I have myself cooked food in water thus heated at the geysers, the celebrated boiling springs in Iceland. Whether this means of obtaining heat would pay is extremely doubtful; it would be a question of the relative expense of very deep boring or raising of coal. As the thickness of the earth's solid crust is variously estimated at from 10 to 400 miles, it would in no case be a very easy engineering task to tap the intensely hot fluid matter of the earth's interior, or even to reach a depth at which we might theoretically expect to find a temperature of 212 degrees. The interesting experiments lately made by M. Spring, of Liege, seem to prove that all matter becomes fluid under extreme pressure, even metals flowing like water under a pressure of 750 atmospheres. These facts seem to settle the vexed question as to the solid or fluid condition of the earth's centre, since, if the hardest metals become fluid at a pressure of 700 or 800 atmospheres, which would obtain at a depth of 12 miles below the surface, no imaginable rock could remain solid at the inconceivable pressure which much exist at 2,000 miles of depth.

They are making great progress with the celebrated Lick Observatory in California. The great telescope, with the large 3ft. refractor, is at last finished, having cost £100,000. It is now proposed to provide a wonderful automatic apparatus. "On enter-

ing the observatory the visitor will pick up a small instrument attached to a rope of insulated wire. It contains nine contact keys, and is made to fold like a book, so that it can be put in the pocket. By touching the first key the visitor lights up the building with electric lights. By pressing the second key he moves the dome and at the same time opens the shutter. By pressing another key the observer can move the telescope in right ascension and a fourth enables him to move it in declination. He has now to bring himself into a position to observe. The dome of the Lick Observatory will be 70 feet in internal diameter. Instead of having to climb into an observing chair, which would be 25 feet high, and very heavy to move, he presses a key, which causes the whole floor to move up or down at will, so that the observer can bring himself within a few feet of the eye-piece, and look through it while comfortably sitting in a low chair." This is a great contrast to the California of 15 years ago. Practical electricity has not apparently made any great progress during the last twelve months, either as a means of locomotion or light. It is true that six telegraphic messages can now be sent through the same wire at the same time, and a small vessel, propelled by electricity, the "Volta" has actually accomplished a voyage to Calais and back, but the great problem of domestic lighting by electricity remains, practically, unsolved. Mr. George Westingham, however, announces that he has discovered a new system of distribution which will reduce the cost of electric lightning some 95 per cent.

It would almost seem that animal instinct trenches closely on reason, if we are to believe an incident related by a scientific journal. It is here stated that a swallow not only set the broken leg of one of its young, but neatly bound up the injured limb with a horsehair. I should mention that this instance of animal sagacity is quoted from an American journal. But if animals are advancing it appears that man is in some respects retrograding. Herr Oscar Schmidt has lately published the result of his researches on human dentition, fromwhich we learn that man will eventually become a toothless animal. It may be gratifying to dentists, but not at all so to most of us, to be informed that our teeth are going from bad to worse, and that dental caries and decay are becoming more and more frequent. We are told too, that prehistoric man possessed a much stronger and more prominent jaw of a decidedly Simian type, and was blessed with ten more teeth than his puny descendants. These teeth used to wear down to the gums in old age, from grinding roots and gnawing bones, but did not decay. This last assertion is apparently confirmed by the recent discovery of two skulls of prehistoric men, of the Neanderthal type, in France. This deterioration of our teeth dates from the

time when man began to cook his food, thereby giving his teeth less work to perform. Had we continued to grind our corn with our molars, and to tear the raw meat from the bone with our canines, we should still possess the useful but less ornamental jaws of our remote ancestors. Oscar Schmidt tells us that as our mental powers improve the work performed by our teeth will diminish, probably by the increased use of artifically digested food, and that the "coming man" will only possess a short receding chin with hard toothless gums, somewhat like the sharp cutting jaw of the turtle.

Chemists continue as indefatigable as ever, and are constantly adding to our medical and dietetic resources. One wishes sometimes that they were less industrious, at any rate when their researches enables tradesmen to supply us with margarine in place of butter, with wine which has never known the grape, and sweets and confectionary flavoured with more or less poisonous derivatives of fusil oil. We have now a new candidate for commercial favour in the form of saccharin, a substitute for sugar, which is called in accordance with the simple chemical nomenclature now in fashion—Anhydro-ortho-sulphamine-benzoic-acid, a derivative of Orthotoluene sulphonamide! This new substance possesses the most powerful sweetening properties, one part in 10,000 of water being sufficient to render it perceptibly sweet. Professor Stutzer has been making a series of experiments on animals by sweetening their food with saccharin, and can trace no injurious consequences to its use. It would be interesting to know if the same views are taken by the dogs and rabbits on which he experimented. Saccharin will doubtless be largely used for sweetening confectionary, syrups, &c., and may perhaps be beneficially employed in medicine. It is said too that quinine can now be manufactured synthetically at the price of 3d. per ounce. This would render us independent of the cinchona tree, and would be an immense boon to thousands, as Quinine at present costs about ten shillings an ounce, only 5 per cent. being extracted from the bark, the other 95 parts being wasted. Thus we may fairly say that although 1886 has witnessed no very brilliant or startling discoveries, Science has been by no means at a standstill. Advances have been made all along the line, and scientists have been as energetic and indefatigable as in bygone years.

A cordial vote of thanks having been accorded to the President for his able and interesting address, the election of officers was proceeded with. The president was re-elected, and the Vice-presidents, and also the committee, with the addition of the names of Mr. Knight, and Mr. A. H. Ullyett. Mr. Hy. Ullyett was re-

elected secretary, the proposer and seconder eulogising his long and valuable services. In returning thanks, Mr. Ullyett alluded to one or two incidents connected with the society. The first was that it was nineteen years ago that it was originated, and he remarked that when it was proposed to establish the museum, twelve members of the Town Council voted upon it, six for and six against, and it was only carried by the casting vote of the Mayor, the late Mr. John Gambrill. The establishment of the museum was not the only good object which had been directly accomplished by the Society, but to its exertions was due the existence of the public library and reading room, the science and art classes, and the new building on the Grace Hill.

February 15th, 1887.

The usual meeting was held in the Council Chamber. An experimental lecture on the Dynamo was given by Mr. A. H. Ullyett, illustrated by the Lantern, and an abundance of experiments.

The attendance was large, and the lecture was warmly appreciated.

THE DYNAMO.

The Dynamo is quite a modern discovery. At the beginning of the present century it never occurred to the scientific men then living—amongst whom was Sir H. Davy—that mechanical motion could be so used as to produce currents of Electricity. But now, since Faraday's great discovery to which I shall presently refer, a tremenduous leap has been made in this branch of the science of Electricity.

According to Professor Thompson, a Dynamo is a machine for converting the energy of mechanical motion, into the energy of electric currents or vice versa; that is if by the means of a machine, or by muscular power motion is produced, and this motion sets up electric currents, the machine generating these currents is a Dynamo. Or if, by means of electric currents motion is produced in some part of a machine, that machine is a Dynamo.

In this box is a battery capable of giving a strong electric current; if the positive and negative poles be connected with the

two binding screws of this little motor, motion is produced and continues until I disconnect the terminals. Here we see that the energy of electric currents has been converted into the energy of mechanical motion, and we have, according to our definition, a Dynamo.

There is one exception that must be made to the definition just given. All machines made for the production of statical electricity, like those of Winshurst and Hotz, must be excluded.

A few simple experiments will enable us to understand better the principle of the Dynamo. On the table we have the two kinds of magnets—the permanent and the temporary. The former is made of steel, and when once magnetised, retains its magnetism, while the latter is made of soft iron, and is only a magnet when the electric current is sent round it; this is owing to the fact that what is known as "coercive force" is greater in steel than in soft iron.

On this stand is poised a magnetic needle, perfectly free to move either way in the horizontal plane. When left to itself it takes up a position nearly north and south; the end which points north is marked by being coloured red. If the north end of another magnet be brought near this coloured end there is repulsion, but if brought near the other end there is attraction. Thus we learn that north repels north, but attracts south, giving rise to the well-known rule "Like poles repel, unlike attract."

Now a magnet is able to exert its force to a considerable distance all round it; this is evident from the experiments I have just performed, for the horizontal magnetic needle is affected long before another magnet is brought close to it. This force exerted by the magnet is very plainly seen by covering one with a sheet of paper or glass, and then dusting over it some iron filings. We have an illustration of this on the table; by means of the lantern we have the same experiment on a larger scale. The iron filings lie in tufts at the ends, and they appear to curve round from one pole to another. These curved lines are called "Lines of Force," and the whole area, occupied by these, is called the magnetic field. These lines of force are always present round a magnet, and by the use of iron filings their presence is made known to us. If the poles of two magnets, or the two poles of one magnet, be brought near each other, the disposition of the lines of force can be plainly seen by the free use of the iron filings. Not only do these lines of force surround a magnet but every electric current is surrounded as well by a magnetic field, which, if time permitted, I could prove to you by using iron filings.

If a piece of soft iron be placed near a magnet, it also becomes a magnet for the time, but of the opposite polarity. Thus by hold-

ing the north pole of a magnet near a piece of soft iron, the nearer end of the iron is of south polarity, and the farther of north. This is called induced magnetism, because the magnetism of the piece of soft iron is induced by the near presence of the permanent magnet.

We can also have induced currents of electricity. If a wire through which an electric current is flowing be brought near a second wire, through the latter will also run a current, but in the opposite direction to the first, and only momentary. So long as the two wires are kept together, no further induced current will flow. But on withdrawing the wire connected with the battery, another induced current will flow through the other wire, again momentary, but this time in the opposite direction to the former one, and therefore in the same direction as the current from the battery.

I will illustrate this by connecting tnis bobbin of wire with this delicate galvanometer, which consists simply of a small magnet placed in the centre of a coil of wire. So sensitive is the magnetic needle in the galvanometer, that if a feeble current of Electricity be started round the coil, it will be defected.

I connect another coil of wire with the battery, so that a strong electric current is sent through it; this one I shall rapidly insert in the bobbin, and the defection of the needle informs us that a current of Electricity has been induced in the wire round the bobbin; but only for a moment; the needle quickly resumes its original position, shewing that no more Electricity is flowing round it.

Directly however I withdraw the coil, the defection of the needle again informs us that another induced current is started, but this time in the opposite direction to the first, as the needle moves in the opposite direction, So we can have induced currents of Electricity as well as induced magnetism. Perhaps this can be shown plainer by using the lantern galvanometer so that the movements of the needle can be thrown upon the screen.

If, instead of a coil of wire being inserted in the bobbin, a permanent magnet be used, we have the same results.

An electro-magnet may likewise be used. Over this powerful one which is connected with the galvanometer, I will rapidly bring down another electro-magnet, this one being connected with the battery, and we have the same approach causing deflection in one direction, and withdrawal in the opposite, and the currents only momentary.

What I particularly wish to draw your attention to is, that these induced currents are only momentary, and that the quicker the approach, or the withdrawal, the greater the deflection, proving

that by these means a more powerful current is produced.

This was discovered by Faraday, and he also discovered that the induced current of Electricity is increased or decreased according to the number of lines of force that were cut. In this diagram the parallel lines represent lines of force. A coil of wire is made to move through the magnetic field without cutting any lines of force; no current whatever is generated in the wire. Neither will there be any if the coil be so moved in the field as to cut the same number of lines of force. But if it be so moved as to alter the number of these lines which it cuts as in these two diagrams, a current of Electricity will be started, and the greater the difference between the number which it cuts, the greater will be the current. This principle is of great importance in the construction of the Dynamo.

In this diagram we have a bobbin of wire moving round in a circle from the North pole to the South pole. The dotted lines represent lines of force. It is very evident that all the time the coil is moving round in a circle, it is not at any two moments cutting the same number of lines of force; consequently all the time it is moving, a succession of momentary currents rapidly follow each other round the wire, and can be collected.

With these preliminary remarks we now come to the Dynamo itself.

These upright blocks of iron, carefully joined at the top, and thickly covered with wire are called the Field Magnets, one being south the other north. They are also shewn plainly in these diagrams. When the Dynamo was in its infancy, the fields were made of permanent steel magnets. It has been found however, that if temporary soft iron magnets be used instead, the efficiency of the machine is greatly increased, chiefly from the fact than an electro-magnet can be made much more powerful than a permanent one of the same size. The ends of the wires which are wound round the fields are not always connected up in the same manner. In what is known as the series-wound Dynamo, the wire is first connected with one of the brushes, wound round the fields, and connected with one of the binding screws; the other binding screw is connected with the other brush. From these binding screws the Electricity is led through wires to wherever it is required. This kind of winding is the best adapted for lighting lamps arranged in parallel arc where the resistance is not very great.

In the shunt-wound as shewn in the diagram, the wire is first connected with one brush, wound round the fields, and then instead of being taken to the binding screw, connected to the other brush. The Electricity is obtained in the main circuit by connecting each of the brushes with one of the binding screws. This kind is best adapted for lamps arranged in series, where there is a much

greater resistance to be overcome, for as soon as any extra work is to be done, an extra current of Electricity is sent round the fields, thus making them stronger magnets, able to induce a stronger current round the armature, and so better able to overcome the resistance.

This, which is caused to revolve between the two poles of the fields is called the armature. It consists of a piece or pieces of soft iron also wound with wire. That of the machine on the table is called Siemens' H armature ; it is all in one piece and the wire is wound longitudinally over it. In the machines of Pacinotti, Gramme, and others, the wire is in several pieces, the end of one coil of wire and the beginning of the next being connected with the same part of the commutator. The way this is done can be seen on referring to these diagrams. This is called the Pacinotti ring armature, and is supposed to be wound with six coils of wire. This number is taken only for the sake of simplicity. The commutator is in the middle, and is divided into six parts corresponding with the number of coils. The end of one coil and the beginning of the next being connected with one of these parts. As the ring revolves it is constantly cutting an unequal number of lines of force which lie between the north and south poles, consequently through each coil momentary currents will be induced.

We must now bring back to our minds what we said at the beginning ; a north pole always induces south magnetism in that part of the iron near it, and north in the other part ; so it is with the south pole. Therefore one half of this ring will have north induced magnetism in it, and the other half south. This magnetism of the ring will induce momentary currrents in the coils round it, the currents in one half flowing round in the opposite direction to those in the other half. As the ring is made to revolve rapidly, momentary currents are so rapidly generated in the coils as to make them apparently continuous currents. The currents which flow in one direction are collected by one of the brushes, and those which flow in the opposite direction by the other.

Now let me explain the important part the commutator plays. In the Siemens' H armature it is in two parts—each being quite distinct from the other. First one end of the wire is connected with one half of the commutator, then wound round the other armature, and the other end connected with the other half. Now although the fields are only temporary magnets, they always contain sufficient residual magnetism to start the Electricity ; therefore as soon as the armature is revolved the poles of the fields act upon it and convert it into a magnet.

Now the Electricity starts in the armature. As soon as this becomes magnetised by the fields, a current of Electricity is started

through the wire which surrounds it. As the wire round the fields is connected with that of the armature, the current passes round these, and in doing so makes them more powerfully magnetic and so able to induce a more intense current in the wire round the armature. After traversing the fields it makes its way through the main circuit and round to the other brush. This brush delivers it up to one half of the commutator, and as one end of the armature wire is connected to this half, the current can flow all through the wire to the other half, and so to the brush and round the fields again. As each half of the armature is alternately north and south for it is made of soft iron, and one brush always collects the Electricity due to north magnetisation, and the other brush that due to south, a steady and apparently constant current is maintained.

I will now throw on the screen a picture of the Gramme Dynamo, and we will see how far its parts correspond with the one I have described.

The armature being somewhat different to Siemen's H, we will will throw that alone on the soreen.

MARCH 8TH, 1887.

The meeting took the form of a Conversazoine. There was an interesting exhibition of a great variety of objects, which were described and explained to the members.

Electrical Apparatus; by Mr. A. H. Ullyett, and Mr. Hambridge.

Botanical and Zoological specimens by Mr. Walton.

Miscellaneous specimens by Dr. T. Eastes.

Dried Australian Plants; a collection presented to the Society by Miss Rutt. Microscopes were lent by the President, Secretary, Dr. Tyson, Dr. Eastes, and others.

Mr. Peden, of Dover Road, brought three instruments and exhibited Vorticellœ and many other living specimens.

MAY 3RD, 1887.

The Secretary was absent through illness. Dr. Fitz Gerald took the chair and read the following paper:

WHY THE SEA IS SALT.

It has been well said that without the sea the world would have remained in a state of barbarism, for civilisation would have been impossible. The sea not only united primitive nations, and

rendered barter and commerce possible, but its apparently boundless immensity probably first suggested the idea of infinity, and thus led to the conception of an Omnipotent and Omniscient Being. To the ocean we are indebted for the first naturalists, in the persons of the primitive fishermen, who cast their nets in the creeks of the Cyclades, and the ancient Phœnician sailors were undoubtedly the first of marine engineers. The ocean covers no less than three-quarters, or, to be quite correct, eight-elevenths of the surface of the earth, indeed if the earth were of one uniform level it would be entirely submerged in the sea to a depth of 600 feet. The average depth of the sea is about 2,000 feet, ranging from a mean of 180 feet in the Baltic to 14,500 feet in the Atlantic and 15,400 feet in the Pacific. One reads sometimes of vast abysses and unfathomable depths of ocean, but the soundings taken by Maury and others prove that there exists nowhere a greater depth than five miles. It is true that a lead line may run out for 40,000 or 50,000 feet, or, indeed, indifinitely, without touching bottom, but this is because the undercurrents of the deep sea have power to bear the line off longitudinally, long after the plummet has ceased to sink. The ocean is continuous all over the earth, and practically maintains the same level, contrary to the belief held not long since that the Mediterranean and some other inland seas were of a higher level than the open ocean. The bulk of the ocean is so great that it has been calculated if all the enormous basins which it now fills were empty, it would require 40,000 years for all the rivers of the earth to re-fill them.

Sea water, when pure, is the most perfectly transparent of all fluids, as I daresay many of you have found out to your cost when you have stepped into one of the transparent pools often found among the rocks at low water. This transparency is of course relative, not absolute, and ceases entirely at a certain depth. Many experiments have been made by Professor Tyndall, Pere Secchi, and others, to measure the extent of this transparency by sinking white plates and various coloured discs attached to a string beneath the surface of the sea, and noting the depth at which they ceased to be visible. It was found that a white disc 12ft. in diameter appeared light green at the depth of a few feet, then blue green, later dark blue, and finally disappeared from view at a depth of 126 feet. Discs of yellow or brown disappeared much more quickly. These experiments were made in the transparent waters of the Mediterranean, and under a bright sunny sky, *i.e.*, under the most favourable circumstances. Now, as the bottom of the sea is never absolutely white, and if it were, could not possibly be seen at a greater depth than about 130 to 140 feet, it is difficult to believe the wonderful stories told by travellers of ocean bottoms

seen at fabulous depths. The waves of the sea usually present three principal tints—blue, green, and yellow. The waters which are of an indigo blue are the purest and deepest of all; those which are yellow contain solid matters, fine sand, mud, &c., in suspension; green indicates water less charged or of a medium depth. In the most profound depths the ocean is almost black. As Tyndall says "You go to bed surrounded by the deep blue of the Atlantic, and wake in the morning and find the sea a bright green, and rightly conclude you are passing over the shallow banks of Newfoundland." But how is it these variously-coloured and minute particles of solid matter produce the same invariable tints of blue, green, or yellow? They form myriads of infinitely small mirrors, reflecting back to the surface the light which has penetrated the body of the liquid. We know, of course, the apparent colour of any object depends not on the rays it absorbs, but on those which, as it were, it rejects or sends back to the eye. Thus a thin layer of sea water absorbs all the rays of the spectrum, except the yellow or light green, which are reflected back to the eye. If the water contains no solid particles, or is of a great depth, the sea appears a deep blue, *i.e.*, only the rays from the extreme indigo end of the spectrum are reflected. It is for the same reason sea-foam appears white, although composed of transparent molecules of water and air. The reflecting surfaces are so numerous that nearly all the rays are sent back to the eye, thus producing the impression of white on the retina. If we take a piece of the most transparent crystal, and pound it into fine fragments, the powder will, for the same reason, appear white, and the self-same cloud in the sky, composed, as you know, of minute molecules of water, may appear the deepest black or the purest white, as it absorbs or reflects the light. Perfectly black surfaces may reflect white light as one often notices, on the hull of some distant ship, which appears white from reflected light. The pure silvery light reflected from the moon is a still better example, giving us an impression of the purest white, although her surface is in reality covered with jagged rocks and mountains of a hue closely approaching to black. Of course these general laws do not apply to instances where the sea is coloured by the presence of sea-weeds, minute animal organisms, or vast quantities of coloured solid matter discharged into it, as, for example, the Yellow Sea of China, whose waters are discoloured by the great rivers which flow into it from the interior, laden with coloured mud. One sees here the reason of the same Yellow Sea, but many seas have been named apparently in reference to their colour where the reason is less easy to trace. The White Sea was no doubt so called from its ice; the Black Sea from its frequent tempests, and the Vermilion Sea of the Californian coast from its waters stained by the influx

of the Rio Colorado. It is difficult to say why the Arabian Gulf should be called the Red Sea, unless it be that it contains a good deal of a microscopic alga (called Trychodesmum erythrœum) of a reddish colour.

The chemical composition of sea water is extremely complex, owing to the numerous and ill understood combinations and double decompositions which occur among its various bases and acids. Analysis shows it to consist of certain simple substances, such as Chlorine, Bromine and Iodine, and four principal bases, soda, magnesia, lime, and potass combined with sulphuric acid. Chlorine is by far the most abundant principal in sea water, no less than half the weight of its saline matter being due to its presence. Soda is the next in quantity, then follow magnesia combined with sulphuric acid, and two substances much more rare, lime and potass. Sea water necessarily contains traces, more or less abundant, of every soluable substance in the world, including gold and silver. It was only in the last century that the silver fcund to exist in sea water was ascribed to the wrecks of the numberless vessels containing specie, especially to the rich Spanish galleons which had sunk with their cargoes of doubloons! The copper sheathing of ships often becomes slightly coated with an amalgam of silver, which, owing to galvanic action, rapidly deteriorates its quality. Small as is the quantity of silver in a gallon of sea water, it is nevertheless calculated by a French chemist, that the ocean contains more silver in solution than there is in circulation among all the nations of the earth. In fact no less a quantity than two millions of tons. So enormous is the bulk of the ocean, that if all the salt it contains could be extracted and spread over the surface of the earth, it would form a layer of 30 feet in depth.—1000 grains of sea water contain :—

Water...	962·0
Chloride of Sodium	27·1
Chloride of Magnesium	5·4
Chloride of Potassium	0·4
Bromide of Magnesia..	0·1
Sulphate of Magnesia	1·2
Sulphate of Lime	0·8
Carbonate of Lime	0·1
Leaving a residuum of	2·9

consisting of sulphuretted hydrogen, hydrochlorate of ammonia, iodine, oxide of iron, copper, and silver.

Our seas thus contain the most powerful mineral waters which exist, and if sea water were only expensive, or limited in quantity, it would be credited with the cure of all the ills which flesh is heir to. Thousands of invalids would rush to any inland town possessing a spring half as rich in mineral matter as the sea, and yet it is hardly ever taken as a medicine, except by sailors, who know its value. In large doses sea water acts as an emetic; the concentra-

ted salts, if given in large quantities, are poisonous, one 400th part of its own weight of marine salt will kill any animal. Sea water owes its bitter taste to the sulphate of magnesia it contains, better known to most of you as Epsom Salts. Pliny tells us the ancient Romans used to transport waters of the Dead Sea at enormous cost into Italy, where its curative properties were highly prized. As we know, the waters of the Dead Sea contain relatively more saline matter, than any other sea, no less indeed, than six times as much. We all know how much easier it is to swim in sea water than in fresh, but so great is the density of the water of the Dead Sea that it is difficult to sink in it, and the body of a man floats on its surface. This great density is due to the fact that no considerable rivers flow into the Dead Sea, so that the loss by evaporation goes on more rapidly than the supply of fresh water. This is the reason why tropical oceans are more salt than northern seas. At the tropics evaporation goes on so rapidly that three-quarters of an inch of the surface water is taken up in twenty-four hours, which amounts to a layer of no less than 22 feet each year, while in the north, evaporation is far less rapid, and the sea receives enormous volumes of ice, which is practically fresh water. Sea water ice, when dissolved, contains no saline matter, or rather it contains only a very small proportion which is mechanically entangled amongst its particles. Sea water, when pure, is quite inodorous; when it has any smell, it is because it contains animal or vegetable matter in solution or suspension, as often happens on our coasts or in harbours. Oysters and other shell fish, especially mussels, will live and thrive in sea water loaded with animal matter in a state of decomposition; part of this they absorb and transform in their interiors into certain very poisonous alkaloids, which chemists call Ptomaines. This is the explanation of the poisonous effects occasionally produced by eating muscles and other shell fish. Although sea water is, owing to the salts of magnesia it contains, usually very unpleasant to the taste, yet oyster eaters will recall the agreeable taste of the water found in the shell of the oyster, and which the animal has stored up in order to carry on respiration. This is due to the fact that this pent up fluid contains always more or less of the vital juices of the animal itself, which was wounded by the knife in the act of opening the shell.

The problem how to render sea water drinkable, has engaged the attention of mankind for at least 1800 years, and even now, despite all our science and chemical improvements, remains practically unsolved. Pliny asserted that a bottle hermetically sealed and sunk deep into the sea, would return to the surface filled with pure water. This statement was implicitly believed until modern times, when a sceptical Italian (Cosigny) tried the experiment,

and it was found, as might have been expected, that when the bottle was not broken by the pressure, it returned quite empty. When the sea water is distilled the evaporated fluid is, theoretically pure, and the salts, of course, remain in the vessel, but it is very nasty, from the presence of some of the more volatile acids, such as the hydrochloric, which pass over in the distillate It is possible, however, to prevent this, but the apparatus for distillation, &c., is cumbrous, expensive, and difficult to manage at sea, and I believe most navies have abandoned the attempt to distil sea water, and content themselves with storing fresh water in iron tanks, which are, of course, far better and more wholesome than the wooden casks formerly in use.

The reason why the sea is salt, is quite easy to understand, although curiously enough, it was not appreciated, until comparatively recently.

Only last century it was thought there existed great beds and rocks of salt at the bottom of the sea. A moment's reflection will show us that sea water must necessarily be salt. All seas are fed by rivers, which, in their turn derive their waters from rain which has evaporated from the ocean, &c. This rain, before it finds its way to the river beds, necessarily percolates through the earth, and dissolves out of it all soluble matters it meets with, which are chiefly of a saline character, and bears them off to the sea. So constantly is this going on and so large is the loss of fluid by evaporation from the surface, that it is wonderful the sea is not more highly charged than it is with saline matter. In the early history of our earth when her surface was still glowing with intense heat, the first showers which fell on the hot rocks, must, by virtue of their high temperature, have dissolved far more saline material than they do at present, and the primitive chasms and valleys which formed the ocean beds of chaos contained a warm fluid intensely salt and of a much higher specific gravity than our present seas. Speaking generally, the loss by evaporation is pretty evenly balanced by rain, and the influx of rivers; where these conditions do not exist, as for example, in the Mediterranean, which receives but few rivers, the waters tend to get more highly charged with salts and the specific gravity is increased. The fishermen of Norway, perhaps the most superstitious of European races, still believe the saltness of the sea to be due to the magic mill which is for ever grinding salt at the bottom of the Atlantic. I daresay most of you know the story, for nearly all our fairy tales are founded upon the Scandinavian folk lore. Once upon a time there were two brothers, one rich the other poor. On Christmas morning the poor brother went to the rich one to beg a piece of bacon, as he had no food. Yes, the rich brother would give it to

him it he would promise to do just what he told him. So the poor brother promised. "Well, here is the bacon, and now go straight to the Devil." The poor man took the flitch. "I have promised and I'll go; but I don't know the way." Shortly afterwards he met an old man with very bright eyes. "I want to go to the Devil," said the poor brother. "Ah many do," replied the old gentleman, "I'll show you the way." So he led him, by a very pleasant road, a long long way till they came to a place with a bright light. When they got inside, all the residents, great and small, swarmed round him wanting to buy his bacon, especially the old gentlemen, for said they, "bacon is much valued here, it fries so well." But no, the poor brother would sell it for nothing less than a hand mill which hung behind the furnace door, and which would grind anything it was told. At last he got it, after much haggling, and went home, "Wherever have you been all this time?" said his wife. "Never you mind; let's have supper." So he put down the mill and told it to grind herrings and broth, bread and cheese, and good brown ale; which it did, and they made a splendid Chri-tmas meal. Next day he ground lots of food and drink and invited all the neighbours, and ground out also several cows, pigs, and horses, so he was soon a rich man. At this his brother grew quite wild and spiteful, and determined to find out the reason, but he would not tell him for a long time, but one evening when he had taken a little too much brown ale he let out the secret. "I will give you three hundred dollars for it," said the avaricious brother. Well he would'nt part with it for a long time, but at last he did. The next morning the rich brother said to the mill, "Now grind herrings and broth, and grind them fast and well." Soon the whole room was full of broth, the rich brother and his wife had to jump on chairs to keep themselves dry; then they had to rush out of the house to prevent being drowned, and there was the rich brother running for his life to get to his poor brother and ask how to stop the mill, he ran and ran, and after him came a whole river of broth, the herrings leaping and splashing and sometimes hitting him on the head. You may be sure the poor brother did laugh, but he would not take the mill back for less than 300 dollars more. Then he set to work again and ground out a grand house tiled with real gold, and a gold churn and milking stool, and was soon so rich that his brother got envious again, and insisted on having the mill back, but he had to give many thousand dollars for it, and the other brother only pretended to tell him how to stop it after all. The next day the rich brother went to sea to fish for herrings, and as he wanted some salt he said "Now mill grind salt and grind it fast and good." Soon the hold was full, and the rich brother tried to stop

the mill, but twist and turn it as he would he could not do so, and the mill ground and ground and the heap of salt grew higher and higher, and at last down sank the boat. And there lies the mill at the bottom of the sea, and grinds away to this very day, and that's why the sea is salt.

Scarcely less fantastic is the fable of Rabelais, who relates how when Phæton essayed to drive the chariot of the sun and collided with the earth. Le globe transpira fortement. Les mers furent le résultat de cette exudation, car, dit-il, toute sueur est sallée. Ce que vous direz estre vray si voulez taster de la votre propre."

The saltness of the sea is of more practical importance than one might, at first sight, imagine. Salt not only increases the dynamic powers of the ocean, renders it more buoyant and enables ships to carry larger cargoes than they could if it were fresh, but it profoundly influences the climate of our globe. Captain Maury says, "From the brine the sea derives dynamical powers and its currents their main strength. Hence to understand the dynamics of the ocean, it is necessary to study the effects of their saltness upon the equilibrium of the waves. Why is the sea made salt? It is the salts of the sea that impart to its waters those curious anomalies in the laws of freezing and of thermal dilatation. It is the salts of the sea that assist the rays of heat to penetrate its bosom." The temperature of the earth depends on the circulation of the ocean, so that the condition of the whole world, both meteoric and climatic, which so profoundly affects the development and maintenance of life, both animal and vegetable, would all be entirely altered were the sea not salt.

At the close of Dr. FitzGerald's paper, a short discussion took place, or rather some further information was asked for, with reference to the influence of the sea upon coast towns, and as to the quantity of sea water which might advantageously be taken medicinally.

Dr. FitzGerald having replied,

Mr. G. C. Walton, F.L.S., proceeded to give some information on the subject of grasses and sedges, a large number of very beautiful and perfect specimens of each order of vegetation being exhibited, and in passing a vote of thanks to Mr. Walton, a hope was expressed that he would pursue the subject further at a future meeting.

JULY 2ND, 1887.

An out-door meeting was held by the Canal side beyond Hythe. Over forty members and friends attended, being conveyed by carriages from Folkestone.

Shortly after three o'clock the Secretary read a paper on "Buttercups," after which a botanical ramble was conducted by Mr. Walton.

Tea was provided in an adjoining field, and a very pleasant afternoon passed rapidly away.

Copy of the Letter referred to on page 17.

TO THE WORSHIPFUL THE MAYOR, AND TO THE TOWN COUNCIL OF FOLKESTONE.

The Museum, Jan. 22nd, 1887.

Gentlemen,—The Committee of the Natural History Society. since 1870, in accordance with an agreement then made with the Town Council, have, as you are aware, had the Museum in High Street, under their charge. It has been their business to classify, arrange, and name the specimens; and in return for this they have been allowed the free use of the room for their meetings, and the sum of ten pounds yearly for petty expenses and cleaning. Of the former privilege however they have for some time been unable to avail themselves, owing to the crowded condition of the room.

It has given them very great pleasure during the last few years to notice the increased practical interest which the public generally, and the Town Council in particular, have taken in the Museum; and they heartily congratulate the town through its representatives on the approaching completion of the new building on Grace Hill.

The Committee wish now to renew their offer of properly superintending the arrangement, classsification, and labelling of the specimens on their removal during the ensuing summer, and to continue to do so as before, under conditions similar to those under the former agreement, viz:—

1.—That the Committee of the Natural History Society be solely responsible for the arrangement and labelling of the specimens.

2.—That the yearly grant of ten pounds for petty expenses be continued.

3.—That in return, the free use of the Lecture Hall, adjoining the Museum be granted to the Society on the first Tuesday in each month, from October to June inclusive, for their own meetings.

4.—That the Attendant be provided by the Town Council.

The Committee of the Society are prepared in addition, with the sanction of the Town Council, to make arrangements for occasional popular lectures in Science and Natural History during the winter to the working classes and others; holding themselves free to charge (if necessary) a small admittance fee, sufficient to cover expenses. It would thus be their endeavour to make the Museum itself a place of instruction and education for the rising population of the town.

We have the honour to be, Gentlemen,

Your obedient Servants,

Signed on behalf of the Committee } C. E. FITZGERALD, M.D., President.
HENRY ULLYETT, B.Sc., Secretary.

The receipt of the above communication was acknowledged; but no further reply having been received, the Secretary addressed a second letter to the Town Council. To this the following reply was sent:—

Town Clerk's Office, Folkestone,
September 22nd, 1887.

Dear Sir,—At a meeting of the Public Library and Museum Committee, held on the 16th instant, a resolution was passed granting to the Natural History Society the free use of the Lecture Hall at the New Museum on the second Tuesday in each month from October to June inclusive, in accordance with the application of the Society.

The Council have now obtained possession of the building, and the Natural History Society can make use of the room in compliance with the above resolution.

Yours faithfully,

W. G. S. HARRISON,
Town Clerk.

Mr. H. Ullyett,
98, Dover Road,
Folkestone.

As no allusion is made in the above letter to the offer of the Society to continue its work of supervision, the offer appears to be not accepted.

Folkestone Natural History Society.

Established for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the summer one or two field excursions are taken.

The subscriptions are of two classes, one Five Shillings per annum, the other Two Shillings and Sixpence. Anyone wishing to join should communicate with the Secretary, at 98, Dover Road, Folkestone.

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VICE-PRESIDENTS :—R L. BOWLES, M.D., T. EASTES, M.D., W. J. TYSON, M.D.

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Rev. C. Bosanquet, M.A.
J. Knight, Esq.
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A. H. Ullyett, F.S.Sc.

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HY. ULLYETT, B.Sc., F.R.G.S.

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J. English, Printer, Folkestone.

FIFTH SERIES.

PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

November, 1887—June, 1888.

FOLKESTONE:
J. English, Printer, 31, High Street.

FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS.

TWENTIETH SESSION, 1887—1888.

November 15th, 1887.

The first meeting of the Session was held in the Council Chamber at the Town Hall, the gas not being yet laid on in the new building. There was a good attendance, and in the absence of the President through illness, the chair was taken by Dr. T. Eastes, one of the Vice Presidents of the Society. A lecture was given "On Grasses and Sedges" by Mr. G. C. Walton, F.L.S. Much interest was taken by the audience in the large collection of fresh and dried specimens, by means of which, together with diagrams, the lecture was illustrated. Attention was drawn to the great importance of Grasses (using the term in its widest sense) as, over vast areas of the civilized world, they furnish food for man and beast. Among the many that might be named, prominence was given to millet, rye, barley, oats, rice, wheat, and sugar. Rice, it appears contains very much less nutritious matter than wheat, which is by far the most valuable of our cereals. Sugar, though obtained chiefly from the sugar cane, exists in some quantities in many grasses. After speaking of the Marram Grass, which is so much planted on sandy shores, where by means of its tough underground stems, it prevents the inroads of the sea, the lecturer went on to the second part of his subject, and dwelt on the main points in the structure of Grasses and Sedges. The stems, leaves, joints,

sheaths, and inflorescence all received attention, the remarks being illustrated by means of a large bamboo and a sugar cane, as well as by several small specimens and diagrams. Silica abounds in the stems (or culms, as botanists call them) of grasses generally. It is no doubt taken up from the soil chiefly in the form of silicate of potash, and is of great service in giving firmness to the stem. Grasses and Sedges are very widely distributed, some of the former even flourishing in the sea. As to height, they range from one inch to fifty feet. Both orders differ greatly in their flowers from other monocotyledonous plants Instead of the brightly coloured perianth of such flowers as the lily, we find here dry scales called *glumes*, enclosing other glumes and either stamens or pistils, or it may be, both. After touching upon other interesting topics the lecturer concluded with a hope that questions and discussion would follow.

A vote of thanks was proposed by the Rev. W. Hall and carried unanimously.

The whole of the grasses of the locality were illustrated by dried specimens.

December 13th, 1888.

The meeting was held at the Town Hall. Dr. Fitzgerald, the president, occupied the chair, and there were present the Revs. C. Bosanquet, W. Hall, and G. C. Martin, Dr. T. Eastes, Dr. Tyson, Mr. Walton, and other gentlemen, and also several ladies. Dr. Tyson read the following paper on

VARIOUS FORMS OF BURIAL.

We must all die! The difficulty of dealing with the body must, however repugnant the subject is to us, be faced. I will begin my paper by giving a short history of the modes of burial that have been adopted in various countries. The first method was that which is, of course, common to all the lower animals, except household pets, viz., of simple exposure, or which might be better described as no burial at all. Thus bodies have been hung up on trees, placed on wooden planks, supported by tall poles, or nations have purposely so exposed their dead, that predatory animals have destroyed them. The next method is that of water burial; of course, this has been more common among maritime nations, than nations who have no sea-board, and is the method still used when death occurs "at sea." The bodies thus buried are doubtless soon devoured by fish. It is interesting to note that the above form has lately been recommended as a universal system, to avoid evils re-

sulting upon inhumation. The third method is that of petrifaction, but this has never reached an extended trial. Another mode was that of covering the entire body with cement, and then entombing it in a coffin of a similar material. But this scheme has found but few adherents. Cave burial is very ancient. Caverns were hewn either in rocks or earth. The early Arabians adopted this method to protect the bodies from wild beasts. We now come to the common method of the present day, "burial in the earth." The earliest and most persistent practisers of inhumation are the Chinese. They have rarely, if ever, adopted any other form. Having no churchyards or cemeteries, the bodies have been buried at places, according to the wishes of the relatives, and on account of the inconvenient positions constantly chosen, have prevented tramroads and roadways being laid down. The treatment of embalming the dead has been carried out by the Egyptians from the earliest times. The origin arose from the belief in the "transmigration of souls"; if the body could be kept for 3,000 years, the soul, they believed, would return to it. Embalming has never quite died out, even in the present day; the advantages of the system seem very small. Lastly, there remains the system of burial known as "Cremation," or burning of the dead. All ancient nations, with the exception of the Jews and Chinese burnt their dead. Still there are instances in the Bible of cremation. In the last verse of the 1st Samuel, we read that after the Philistines had defeated the Israelites and slain Saul and his three sons, their heads were cut off, and their bodies fastened to the walls of Beth-shan. "And when the inhabitants of Jabesh Gilead heard of that which the Philistines had done to Saul, all the valiant men arose and went all night, and took the body of Saul and the bodies of his sons from the wall of Beth-shan, and came to Jabesh, and burnt them there. And they took their bones and buried them under a tree at Jabesh." In the last verse of the 16th Chap. of II. Chronicles, we read concerning Asa: "And they buried him in his own sepulchre, which he had made for himself in the city of David, and laid him in the bed which was filled with sweet odours, and divers kinds of spices prepared by the apothecaries' art; and they made a great burning for him." In the same book we find that Josiah burnt the bones of the Priests of Baal. The Jews, we know, burnt their dead in the Valley of Hinnom. In our own country the practice seems to have been common, urns being occasionally found at the present time. Having thus most briefly given you the modes of burial adopted in past and present times, I will now touch upon some of the causes that led to our present system, and the origin of our burial laws. In 1839, Mr. Walker, a London surgeon, brought to the notice of the Government of that

day, the risks that were being incurred by the then custom of inhuming the dead in the midst of the living. Overwhelming evidence was brought forward, proving that severe epidemics were caused by the careless overcrowding of the graveyards and church vaults of London. Three years later, a government inquiry was instituted, and soon afterwards reports were issued by Lords Carlisle and Ashley, Mr. Edwin Chadwick, and Dr. Southwood Smith ; these sufficiently showed the great need that existed for instant reform. Since 1843, many of the general and parochial burying grounds have been closed, but it was not until 1855 that the present law, known as the "Burials Act," came into force. This act gave power to the local authorities to shut up, and regulate all the graveyards which were "conducted in such a manner as to be dangerous to health, or offensive or contrary to decency." The parochial boards and Burgh Councils were empowered to take ground for the providing of cemeteries for the people. I quote from Dr. Duncan's pamphlet, "on the reform of our present method of disposal of the dead," the following paragraph : "Private cemetery companies have been originated in our large cities to provide for the graveyard accommodation of the community, provision for which has been neglected by the public bodies, which ought to have provided it under the powers of the Burials Act of 1855. The shares in these companies were early taken up by the commercial classes, because it was known that large profits could be realised. In graveyards as on house property, the greatest profits are extracted from the pockets of the poor. These profits are got because the cemeteries so provided by private enterprise are not under the regulations of the Burial Grounds Act. Although originated by humane and public spirited citizens, they are now conducted on purely commercial principles, and are permitted to ignore laws of sanitary science and considerations of public decency, to which, were they under a public censorship, they would be compelled to attend." The above state of things, and also the absurdity of attempting to keep our dead as long as possible, then seal them up in oaken and leaden coffins, led Mr. Francis Haden, of London, to write letters to the *Times* in 1875. Mr. Haden says "How then are we to bury our dead ? Clearly within a reasonable time of their dissolution, and in coffins (if we must have coffins) of such a construction as will not prevent their dissolution. No coffin at all, would, of course, be best, or a coffin of the thinnest substance, which would not long resist the action of the earth, or a coffin, the tops and sides of which admitted of removal after the body had been lowered into the grave, or a coffin of some light, permeable material, such as wicker or lattice work, open at the top and filled in with any fragrant

herbaceous matters that happen to be most readily obtainable. A layer of ferns or mosses for a bed, a bundle of sweet herbs for a pillow, and as much as it would still contain, after the body had been gently laid in it, of any aromatic or flowering plant for a coverlet; such a covering, in short, as while it protected the body from immediate pressure of the earth as effectually as the stoutest oak, would yet not prevent its dissolution. I can conceive no better form of coffin: Let us emulate, too the healthy sentiment of those elder Jews, who considered it an indignity and an injury to be refused prompt burial, and so made it an offence to the living, and bury, while it is still grateful to every sense, and while, if we feel it an effort, and a sacrifice to part with it, we may also feel that we are making that effort, and submitting to that sacrifice, in the cause of the dead." Soon after this, a society was formed called the "Church of England Burial Reform Association," with the Archbishops of Canterbury and York as Presidents. The objects of the Society were to lessen the great expense usually attendant on funerals, the disuse of crape, early interment, and the use of perishable coffins. I am sorry to say that these objects have not all been carried out, but doubtless a great advance has been made. Some of you can probably remember the long silk hat bands, the silk scarfs and black leather gloves that were formerly lavishly used, and even perhaps have worn or seen worn the garments that were subsequently made up. Were ever such things an inducement to atttend? I hope not. Happily these unnecessary adornments and the use of mourning coaches have almost died out. The last two objects, viz., early interments and perishable coffins, are still only in a small degree lessened. I believe that the leaden shell, so common a few years ago, is rarely now used. The poor spend a most unnecessary sum of money on funerals; rarely is a funeral conducted under £5, and when all the clothes are paid for, a much larger amount. No funeral, I believe, need cost more than £2, whether it be for peer or pauper. I see in the *Morning Post* for Dec. 12th last, that the 9th annual meeting of the above association was held in the Chapter-room, St. Paul's Churchyard—the Bishop of Bedford in the chair. The Chairman spoke of the undue extravagance in the matter of floral decorations, and adverting to the desirability of introducing wheeled biers into rural parishes, he said that he had presented one to his own country parish, and had recently set the example of simplicity by having it used in the case of his own sad loss. The following resolution was passed:—That it is desirable to recognise that there is no common law right to a perpetual ownership of the soil for the buried, and that incumbents can decline to sanction the construction of bricked

graves and vaults, in the churchyards of which they are trustees. I propose now to state more in detail the reasons for and against the mode of burial known as cremation. I do so because the subject is just now being much talked about, and there is a vast amount of ignorance which should be dispelled. Now, I take it, that the reason why the above form of burial is causing a good deal of interest, is that the present mode of burial is becoming rapidly a question of health to the community at large, and secondly that the present funeral expense is a most unnecessary item to incur. Had there been plenty of spare land, and had our population kept within moderate bounds, cremation possibly never would have been heard of in this country. To show you the evils that may happen when bodies are carelessly and imperfectly buried, I quote the following incident: In 1849 the burial pits were opened in vacant ground some distance behind the Glasgow Royal Infirmary. In these pits were interred in masses the bodies of those who died of the cholera epidemic of that year. In 1861 the new surgical department of the Royal Infirmary was built on the edge of these old cholera pits. The site was praised at the time as a fine, open, healthy site. The persons who chose had evidently forgotten about the mass of putrefying matter that lay beneath its surface. The result might have been predicted with certainty from the well authenticated case of a Parisian Hospital, which had suffered from being built in a similar proximity to a graveyard. Hospital gangrene and pyæmia broke out among the patients. These diseases became so common that one of the surgeons protested against being compelled to treat his patients under these conditions, and threatened to resign unless something was done to purify the soil beneath his wards. The managers were compelled in 1867 to dig into this cholera pit, and destroy, and deodorise the undecomposed remains with quicklime and other chemical agents." In 1843, when the parish church of Minchinhampton was rebuilding, the soil of the burying ground, or what was superfluous, was disposed of for manure, and deposited in many of the neighbouring gardens. The result was that the town was nearly decimated, The two foregoing calamities will suffice for our purpose. Knowing then, as we do, that a body left to itself returns to dust, is it not strange that for centuries we have been trying to retain, in fact, to shut up substances which belong to the soil. Sir Henry Thompson says, in speaking of the disintegration of the body, "Do that which is done in all good work of every kind—follow nature's indications, and do the work she does, but do it better and more rapidly. The problem to be worked for is—given a dead body, to resolve it into carbonic acid, water, and ammonia, and the mineral elements rapidly, safely, and not un-

pleasantly. The answer may be practically supplied in a properly constructed furnace. The gases can be driven off without offensive odour, the mineral constituents will remain in a crucible, The gases will ere night be consumed by plants and trees. The ashes or any portion of them may be preserved in a funeral urn, or may be scattered on the fields, which latter is their righteous destination. No scents or balsams are needed, as on Greek and Roman piles, to overcome the noxious effluvia of a corpse burned in open air. Modern science is equal to the task of thus removing the dead of a great city, without instituting any form of nuisance ; none such as those we tolerate everwhere from many factories, both to air and steam. Plans for the accomplishment of this have been considered." The above quotation puts the case strongly for the cremationist. The argument most commonly brought against cremation—it was used by the Home Secretary in 1884 in reply to Dr. Cameron's speech, in support of the Bill for the "Disposal of the Dead"—is that crimes of violence and secret poisoning will then go undetected. Now, as regards the former, the probability is, that the body would be subjected to a much more searching and rigid examination before cremation than is ordinarily the case, and thus any injury would be more likely to be discovered. The present mode of examining bodies before burial is most carelessly done. As regards secret poisoning, we have to consider the organic poisons and the metallic ones. The former undergoes the same change, whether cremation or common burial takes place ; the latter, after cremation, would remain in the ashes, with the exception of arsenic. For the same reason as mentioned just before, the poison would be almost as likely to be traced as now. One of the strongest arguments advanced in favour of a radical change in our burial laws, is the present lamentable insecurity that exists for finding the true cause of death Our burial laws contain elaborate provisions for certificates, which most of us are pleased to consider as affording all the security required or possible for the discovery and registration of the cause of death. But anyone who chooses to look into the subject will see that this is a mere delusion, and that, however efficacious our system may be for the preservation of evidence of the effect of death, so far as regards the exact mode of death, or its occurrence from natural or criminal causes, our system is utterly unreliable in the very instances when it is most important that it should work effectively. A very large number of our population die without any medical attendance at all, or at least without having ever received sufficient medical attendance to enable a certificate of the cause of death to be given worth the paper on which it is written. In many of these cases some sort of a worthless certificate is procured and presented to the registrar, but many

thousands of persons are each year buried in the United Kingdom without even this formality. The attention of the public and of the Government has been drawn to the subject again and again, but neither the public nor the Government like to be made uncomfortable, and nothing has been done to amend it. So far back as 1843 Mr. Chadwick, in his report to the Board of Health, on the subject of Intramural Interment, devoted an entire chapter to the dangers of our existing system, and the necessity of an alteration in our law as to the verification of the cause of death (Dr. Cameron). Again, in 1851, in the Report of Health on Extramural Sepulture, the second paragraph reads as follows:—"We have also received much evidence showing the practical evils that result from certain defects in the present system of the registration of deaths, the facility consequently afforded for the perpetration of crime, especially in the case of infants reputed to be stillborn, and the neglect which is more common than is generally apprehended of calling in medical assistance to infants, children and others, when sick; the importance of verifying the cause as well as the fact of death has been very generally and urgently represented by magistrates, coroners, clergymen, and medical men." In the report of the Registrar-General for 1884, out of a total of about half-a-million of deaths, only ninety per cent. received medical certificates. The returns showed this remarkable fact that in one year 20,000 people were buried without any medical certificate whatever. In Scotland things are said to be much worse. Here there are no coroners, but instead procurators-fiscal, and these only investigate cases that they suspect have died from crime. Dr. Allison, once a well-known Edinburgh physician, stated that in Scotland there is full opportunity for the perpetration of murder, without investigation by any responsible officer. He remembered two cases, within two or three days, of children overlain and killed by their parents while in a state of drunkenness, and no note taken of the circumstances by anyone" There is another difficulty which will soon have to be met by legislation. It is this, that cremation is practically lawful, and can be carried out in any place, at any time, and almost under any circumstances. In 1769, the body of Mrs. Pratt, in accordance with her wish, was burnt in Tyburn, burying-ground. But this case was taken little heed of, until Dr. Pryce burnt the body of his own child, a few years ago, on a Welsh mountain. This became a test case. A trial was instituted at Cardiff in February, 1884, at which Mr. Justice Stephen gave his well-known charge on the law of cremation, the gist of which is that unless the cremation process constitutes a public nuisance, or leads to a breach of the public peace, no action can be taken to prevent such an operation of cremation

being undertaken. Since the above charge was given, several cremations have been carried out in this country. Captain Hanham cremated his wife and his mother in a crematorium which he erected in his private grounds in Dorset, and a year later he was publicly cremated in the same place. The Cremation Society of England, which was founded in 1874, soon after obtained a piece of ground at Woking, upon which a crematorium was built. Since Mr. Justice Stephen's charge, several cremations have taken place in it. The Metropolitan Commissioners of Sewers have appointed a committee with the view of considering the propriety of erecting a crematorium at Ilford. Now, although the rules that have been drawn up by the Cremation Society of England are most excellent and stringent, and would effectually prevent any foul play, the company possesses no monopoly in cremating, so that any one who may desire can cremate another without even a burial certificate being required. This state of things ought not to last. If cremation is legal, then it should be doubtless under strict governmental control. There is a subject in connection with burial which I think should be mentioned, viz., the dread which many people have of being buried alive. I once heard a person say "that he should like to be exposed on a church tower for a week after his death, so that there should be no possibility of his being in any form of a trance at the time of burial." Of course, shut up in a closed coffin, would produce an almost immediate suffocation. Under the crematory process, no fear of premature burial need be thought of. The economical question of burials is a serious and a pressing one. Cemeteries are most expensive establishments to keep going, and at the same time occupy a large amount of ground which might be otherwise more profitably used. The sanitary side will have to be some day if not shortly, seriously considered. The air over cemeteries is much contaminated, and from this cause many epidemics have arisen. The water also becomes polluted from percolating through burial grounds. Water thus impregnated often runs into streams from which drinking water is used. In concluding, I may say that I have tried to give you a concise history of the past and present burial systems. The disagreeableness of the subject has led comparatively few people to take any energetic practical interest in it. The question cannot be shelved for a much longer period, as it carries with it important sanitary and economical considerations. I am not here to advocate any one pet cause, but nevertheless you must have gathered from what has been said that the present mode of conducting cemeteries, the presence of brick graves, vaults, and impervious coffins, need only to be thought about for a few moments, with an ordinary amount of reasoning, to be condemned in almost unqualified terms. The

defects and omissions in my paper will give you good opportunities for discussion, which I trust will be free, and help to extend the knowledge of the subject.

At the conclusion of Dr Tyson's paper, a few remarks were made by Dr. FitzGerald, Dr. Eastes, the Rev. C. Bosanquet, the Rev. G. C. Martin, and Mr. Walton, all of whom agreed with Dr. Tyson in his idea as to cremation being the best and most sanitary method of disposing of the human body after death. Mr. Bosanquet and Mr. Martin spoke very strongly against the present system of enclosing bodies in lead and oak coffins and placing them in the ground, where their disintegration was delayed as much as possible. Mr. Martin attributed a long illness which he had suffered to the fact of his having attended a funeral at which the corpse was in an advanced stage of putrefaction, and Mr. Bosanquet said they all knew the peculiar smell which was noticeable in old churches, which they were told was the port wine consumed by their ancestors, but which they knew was something very much worse. He added that in his own church there was one grave from which he always fancied he could detect an odour arising.

A vote of thanks to Dr. Tyson for his excellent paper was carried by acclamation.

MARCH 27TH, 1888.

This was the first meeting held this year, the committee having been waiting for the opening of the New Museum. As however the date was still uncertain, this meeting was called in the Council Chamber at the Town Hall. The night was exceedingly unpropitious, and the attendance was consequently rather thin. In the absence of the President, the chair was taken by Dr. T. Eastes, V.P., who called on the Secretary to read his paper on

THE DIFFICULTIES OF SCIENTIFIC BELIEF.

It is not my intention this evening to enter upon any arguments either for or against certain articles in the scientific creed of the present day; I only wish to show that to those who travel but a short distance within the borders of the realm of science, there are difficulties in the way of their acceptance. With the very slight amount of scientific knowledge which I have been able to acquire it would ill become me to set up my thoughts and conclusions against those who have grown grey in exploring the mysterious and hitherto unknown realms of Nature. And more especially so, because in my daily work I cannot avoid building much of my teaching on the foundation of these said doctrines. They may be true, or they may not, we are not concerned with that point to-night, and in what I say I do not wish to cast the least doubt upon one of them; for all the purposes of this lecture we may, if we choose, take it for granted that they are true. That some of them are startling to the mind, and difficult of acceptation cannot be denied; and this is the only point I wish to dwell upon in my paper. The more educated we become, in a scientific direction, the more inclined we are to receive these mysterious doctrines, and the more the probability of their truth increases in our minds.

You remember how Antony in his skilful oration over the dead body of Cæsar, while rehearsing the good points of his friend's character, was still careful to defer (at least in appearance) to the superior knowledge of Brutus; and how each time after praising him he adds—

> But Brutus says he was ambitious,
> And Brutus is an honourable man.

So let me, this evening, while drawing your attention to some of the bewildering thoughts connected with certain scientific doctrines, shelter myself, even while asserting their seeming improbability, under the authority of those whom I unreservedly acknowledge to be both scientific and honourable.

To make it plainer concerning my intention. Religious people, as such, have been, and still are constantly twitted with believing that which cannot be comprehended, and which may in some instances be opposed to the evidence of our senses, or to the dictates of our reason. We are told that we ought to believe nothing which cannot stand the test of logic and experiment. Well, so be it, for the purposes of my remarks this evening. I wish to justify to some extent our apparent unreasonableness by a retort on our opponents after what is known as the *tu quoque* method, or amongst less logical people, the "You're another" style of argument. It is not I grant, the most dignified method, but it is often more or less effective, and it is justified by the proverb, "They who live in glass houses should never throw stones."

Now it might be imagined from the persistence with which the attack is made upon so-called religious credulity, that the scientific creed is perfectly free from mystery, and that every article in it may be readily proved and understood. It will be my endeavour to show that such is not the case by any means; that in some of the scientific theories there is quite as much of mystery, and of that which cannot be comprehended as in any article of religious belief; (*a*) that some of them are as contrary to all experience as miracles are said to be; to show also that if Christianity is dogmatic, science is equally so, if not in a greater degree; that if a too implicit confidence be demanded by authority in Religion, a no less implicit reliance on scientific authority is required. (*b*)

I think we have less encouragement to trust to authorities in matters of science than we have to trust in religious authority, since we find the theories confidently put forward for acceptance so frequently breaking down. I may be told that scientific men are always ready to acknowledge themselves in the wrong, when shown to be so. In the generality of cases I grant it, but their failures do not make them less dogmatic; they immediately put forward a new theory, and insist on its acceptance no less strongly than before, while for aught we laymen can tell it may fail in a similar way. But to hasten to the points more immediately before us, let me mention now one or two articles in the creed of science, and endeavour to make good my assertion, that whether founded in truth or not, they are very difficult of acceptance.

(*a*) "The theory of the universe which reduces universal causation to the pullings and pushings of the final particles of matter, and which we are so often called upon to believe—under pain, as it were, of intellectual reprobation—offers unspeakably greater difficulties to the intellect than any form of Theism with which I am acquainted."—W. S. Lilly, 19th Century, August, 1888.

(*b*) "I see no other way for you, laymen, than to trust the scientific man with the choice of his inquiries; he stands before the tribunal of his peers, and by their verdict on his labours you ought to abide."—(Tyndall on Light, p. 66).

MIND AND MATTER.

It has long been believed that Mind and Matter, although closely connected, yet are in their properties utterly unlike each other; that these properties are in fact so diametrically opposed, that we cannot possibly imagine the same substratum endowed with both sets at the same time. Matter possesses among other properties weight, extent, divisibility, impenetrability, &c. Mind possesses none of these. Who can speak of the length of a choice, the weight of fear, or the geometrical shape of anger? Physically matter can be divided into molecules, chemically into atoms, but who shall perform such operations on Mind? This infinite unlikeness has to thinking men of all ages been so evident that mankind long ago came to the conclusion that there must necessarily be two substances in existence, one material, the other im-material, each endowed with its own peculiar set of properties. But now we are frequently told by scientific and metaphysical authorities that Matter itself, *as* matter, contains all the promise and potency of life. One of our greatest thinkers (*a*) who appears to fully believe in the wide gap existent between Mind and Matter, nevertheless believes that matter in itself developed mind. If so, then all connected with mind,—emotion, intellect, and will,—were once latent in the nebulous haze from which our universe is imagined to have been evolved, and from it have been developed by its own innate power the strategy of a Wellington or a Napoleon, the genius which inspired Shakespeare's Plays, the magnificent enthusiasm of humanity evinced by a Howard or a Gordon. But if these two substances are so utterly opposite in their natures, if there is a gap between them, (*c*) on the brink of which the intellect stands bewildered, and helpless to cross it, how can we readily believe that mind, the sentient, the conscious, that which can perceive, and originate, has ever been the mere product of inert, blind matter? "The unknown *y*, that is matter, must by sheer physical vicissitudes, actually abnegate its own qualities, and emerge, no longer *itself y*, but another entity, infinitely unlike itself, that is, *x*! If Mind and Matter are divergent from each other by infinite unlikeness of quality, the mind refuses assent, that any process, based on the foundation of accurate human knowledge, would sanction the emergence of mind by physical processes from matter. Mind is the antithesis, and cannot be a function of matter." (*d*).

(*a*) Herbert Spencer.

(*c*) "We may think over the subject again and again, but it eludes all intellectual presentation. We stand at length face to face with the incomprehensible."
Tyndall, Fragments of Science, Vol. II., p. 394.

"I know nothing whatever, and never hope to know anything of the steps by which the passage from molecular movement to states of consciousness is effected."
Huxley, Contemp. Review, Nov. 1871.

(*d*) Dallinger's Fernley Lecture, p. 45.

Such words show you far better than any of mine could, the difficulty of this form of scientific belief. If Mind be evolved from Matter there can be but one substratum, not two; all the old ideas must be incorrect, and this one substance possesses at the same time two sets of opposite properties. I think we must allow that this is but making a mystery more mysterious still. We shall require a new definition of Matter, the nature of which however has not yet been determined.

MOLECULES AND THEIR MOTIONS.

A mass of matter of any kind is supposed to be made up of a number of minute bodies which are called *molecules.* We define a molecule as the smallest possible particle of a substance that can exist alone. It is in itself compound, often exceedingly complex, being composed of still minuter particles called atoms; but being the smallest particle of a substance that we can even think about; the moment a molecule is broken up by chemical action its nature is changed; it enters into new arrangements and is no longer the same substance. No person has ever yet seen a molecule, in all probability no one ever will; the minutest grain visible under the most powerful microscope contains thousands of them. Yet in spite of this great disadvantage our scientific guides tell us they have been approximately measured; and the diameter of one cannot be less than the 500 millionth part of an inch. The number of them in a cubic inch of air at a freezing temperature would be represented by the figure 3 with twenty ciphers after it, while a drop of water, in which they would necessarily be packed more closely together, contains a number represented by 100 followed by twenty-four ciphers. The physicist, like the astronomer, deals with numbers infinitely large, but he also deals with sizes infinitely small. Now these particles are never at rest, they are always in rapid motion even in the densest solid, but necessarily moving within narrow limits; so that even if we accept *inertia* as a property of matter in the mass, it does not appear to be a property of its constituent molecules, and therefore it is not an *essential* property of matter, though our text books have always taught us that it is. And again if we grant that the molecular movements are the consequence of some primal force originally acting on them, but not now, do we not get perpetual motion, which we are told is an impossibility? In liquids the limits of vibration are wider than in solids, but the greatest molecular freedom is found in bodies in the gaseous condition, and here the rapidity is enormous. According to accepted calculations and experiments the particles of hydrogen gas at a freezing temperature are moving about at the

rate of 6055 feet per second, a higher velocity than that of the swiftest cannot ball, and it increases with every rise of temperature. Well it necessarily follows that these gaseous molecules, darting about with this inconceivable velocity, must be constantly striking against each other and darting off in new directions. Clerk Maxwell has been at the trouble of calculating how often this occurs, and he tells us that at ordinary temperature and pressure each particle in a mass of hydrogen makes on an average 17,700,000,000 collisions in every second. We listen to these numbers, or we read them, and generally unquestioningly pass over them; what if you stay to think of them? Do you find it a simple thing to grasp the idea of 17,700 million separate and distinct collisions *every second of time*? Or does this scientific statement, like many religious truths wear the aspect of the mysterious and the improbable? It may be true; I am not arguing against it; but taking its truth for granted no miracle ever yet recorded wears such an air of improbability.

These molecules are supposed to have been thus madly rushing and clashing together from all eternity; for notice, though we deserve pity for believing in an Eternal God, we are expected to believe in the eternity of Matter and Force. You would ask, perhaps, what has been the result of this interaction of atoms and molecules from all eternity? The answer given to you is—the present state of affairs, the "Nature of Things;"—our UNIVERSE with its magnificently marshalled suns and planets, and the laws by which they act;—our Earth with all its beneficial arrangements for its inhabitants; the adaptation of man, bird, and beast, insect and plant, each to its surroundings, and all to each other; the structure of man himself, physical and psychical;—these all are the results we are told of the "fortuitous concourse of atoms."

> "I saw the flaring atom-streams
> And torrents of the myriad universe,
> Ruining along the illimitable inane,
> Fly on to clash together again, and make
> Another and another frame of things
> For ever.' '(e)

There has been no Mind at all at work as a controlling power, and whatever mind does exist is a production of the unguided motions of these blind indestructible material particles. We have laws, but there has been no law-giver; "Atoms, individually dead, without sensation and intelligence, get up of themselves, run together, form all actual and imaginable combinations, as if under a drill master, but without a drill master. Each one by itself is dead; yet, together they live. When apart they are without sensation, possess no intelligence; but collectively they possess

(e) Tennyson's "Lucretius."

sensation, are full of wisdom, and form the universal mind, if there be any mind." *f.*

All this possesses the virtue of antiquity; though taught in the nineteenth century, it is not the product of nineteenth century thought; "there is nothing new under the sun;" and we have here but the resuscitation and adoption of a philosophy first put into a concrete form by *Lucretius*, who, living in the first century before the Christian era, taught that "Nature is seen to do all things spontaneously of herself without the meddling of the gods." So we go back nearly 2000 years for the articles of our scientific faith—just as we do for those of our religious faith. Well, suppose it all true; is it, I ask, more easy to accept than the statement, "In the beginning God created the Heaven and the Earth?" Does it contain less or more of mystery than that simple verse? We are told that this Biblical statement is improbable, or that is all unknowable; then the only agent to fall back upon is *chance.* "There is no alternative" says Dr. Dallinger, "either chance, or mental purpose gave primal origin to all that is. Nothing within the reach of intellect could express the infinite improbability of the first suggestion. That *one* vast harmony, one *perfect* method, should fall out by chance, through the operation of uncounted millenniums of ages, is almost inexpressibly improbable; but that a *system of harmonies* practically infinite in number and measureless in extent, should all be locked together in one vast uniting harmony, making all creation a chorus, to which all its parts form the centre to the margin contribute their flowing and concerted strains, without a discord to the unity of thought; to say that *that* arose by chance, sprang from fortuity, fell out by accident, is surely to trifle with the fundamental principles of our moral faculties and reasoning powers." (*g.*) Why all this endeavour to exclude a Creator? Why this disregard of all the laws of thought and of all the teachings of experience? From birth onward thro' the whole of our life we learn that every contrivance must have had a contriver, every machine a maker who understood what he wanted, and what he was doing; but directly we study the contrivances and machines in Nature we are told to stop, to disregard all experience, to draw no conclusions. Is this true Science?

EVOLUTION.

Closely connected with these remarks is the theory of Evolution. I do not refer it its explanation as put forward by Darwin or others but to the simple theory itself, namely, that every living species has been evolved by slow and imperceptible steps, and by Natural

(*f*) The supernatural in Nature.
(*g*) Fernley Lecture p. 17.

Laws out of some other species which preceded it, and that the same process, having regard to the age of Matter, has been going on from all eternity, and is at work still. I do not know whether I am justified in talking of the "*theory*" of Evolution, since Professor Huxley in his article "On the Coming of Age of the Origin of Species," says "Evolution is no longer a speculation, but a statement of historical fact"! How that can be an *historical* fact which has never yet been known spontaneously and naturally to occur, and which no man, living or dead, has ever pretended to see or hear of, passes (I must confess) my apprehension. Some evolutionists deny an original creation, or any special creation at all (*h*). Others seem disposed to allow an original creation, but reject a present Creator, or Superintendent of any kind. Nothing, they say, shows any *design* in the mode of its formation; animals and plants were not made as they are to suit the circumstances in which they are placed, but the circumstances themselves have made them what they are. We have been created by our environment. No matter how intricate, even microscopically, any structure may be, all its intricacies have been evolved by the force of circumstances, not by a controlling mind. The eye with its various coats and lenses, its delicate meshwork of nerves and vessels to receive external impressions, was not made *for* seeing, nor the ear *for* hearing; nor, say they, is it in accordance with scientific thought to judge that the complexity of either shows any trace of design. It has all grown up piecemeal through the long eternity of ages. The apparent improbability of this is to a certain extent acknowledged. "To suppose" says Darwin, "that the eye with all its inimitable contrivances for adjusting the focus to different distances for admitting different amounts of light, and for the correction of spherical and chromatic aberration, could have been formed by natural selection, seems, I confess, absurd in the highest degree." But he then goes on to show how highly probable it is that such was the case. You would perhaps like to know how the formation of the eye has been accounted for by scientific men. I will give it you in Professor Tyndall's own words.

> "The action of light in the first instance, appears to be a mere disturbance of the chemical processes in the animal organism, similar to that which occurs in the leaves of plants. By degrees the action becomes localized in a few pigment cells more sensitive to light than the surrounding tissues. The eye is here incipient. At first it is merely capable of revealing differences of light and shade produced by bodies close at hand. Followed as the interception of light is in almost all cases by

h) "No one" says Herbert Spencer "ever saw a special creation." To which the *tu quo que* reply has been made, "No one ever saw an evolution."

> the contact of the closely adjacent opaque body, sight in this condition becomes a kind of 'anticipatory touch.' The adjustment continues; a slight bulging out of the epidermis over the pigment granules supervenes. A lens is incipient, and through the operation of infinite adjustments, at length reaches the perfection that it displays in the hawk and eagle." (*i*)

There you have it accounted for in all stages of its development. It is possibly true, but I ask, is there no mystery there? (*k*) You ask for the grounds on which such an explanation is based,—whether any of these developments have been traced in any one instance. Well no; never; but then you see it is *so likely* to have been the case. You may see the different stages in the eyes of different classes of animals; whence it is concluded that *all* eyes passed through such stages (as in fact they are found to do in the embryo of some creatures) until they reached the condition in which we possess them. They are even now we are told very imperfect. Professor Helmholtz speaking of the eye declares, "It is not too much to say that if an optician wanted to sell me an instrument which had all these defects, I should think myself justified in blaming his carelessness in the strongest terms and giving him back the instrument." And yet it was the Professor's imperfect eye with which he discovered its own imperfections.

THE ETHER.

I come now to what I fearlessly assert to be the crowning mystery in science; to some of the most astounding facts, if facts they be, presented for our acceptance:—those connected with that subtle, all pervading fluid, and "inter-stellar medium," known as the Ether. It is what we may call the atmosphere of infinite space, a fluid refined and rarified beyond all conception. Just as the air fills every crevice, corner, and cranny on the surface, and in the crust of our globe, and extends from it some two or three hundred miles out into space, so does this hypothetical fluid occupy the substance of everything, gaseous, liquid, or solid; extending between planet and sun, system and system, nebula and comet, throughout all creation. It stretches itself

> "From star to star
> From World to luminous World as far
> As the universe spreads its flaming wall."

So refined, so subtle, that unlike atmospheric air it interpenetrates all substances, even hard as the granite rocks filling up all the

(*i*) Tyndall's Belfast Address, p. 48.

(*k*) "Well let us suppose that this is so, as I, for my part have no difficulty in believing. And pray, how does it tell against the Divine induction? * * * Surely this is a more reasonable hypothesis than that which explains so marvellous a development by chance or blind necessity," Lilly, 19th Century, August, 1888.

imagined spaces between the imagined molecules, just as particles of sugar when dissolved are distributed throughout a vessel of water. It is the medium whereby light and heat are conveyed from the sun to the earth, and from the lamp on our table to the book we are reading. It forms a boundless, shoreless sea, in and throughout which worlds, systems, and universes are scattered like islands and archipelagoes in an infinite ocean. Without it there would be eternal darkness and an utter absence of heat. It is an unquiet sea too, one that is never at rest, an ocean that knows no calm. It is in a continual tremor, and billions on billions of infinitesimal waves are rolling across and athwart it every instant of time, and in every possible direction. But it is invisible, and completely defies positive detection. It does not appear to be subject to gravitation, as *all* other kinds of matter are; and it is non-molecular, as *no* other kind of matter is. It is a pure invention, totally and completely unlike any form of matter with which man is acquainted, and one which he has been obliged to endow with opposing properties. There is not the slightest direct proof of its existence; like other theories this depends for proof on the Balance of Probabilities,—the identical kind of proof, notice, by which we establish the existence of a Creator. Yet no scientific man doubts the fact of its existence, neither must we, if we have any hope of understanding the laws of light, heat, electricity, and magnetism. "Of its reality," says Tyndall, "most scientific men are as convinced as they are of the existence of an atmosphere." And I cannot see how we are to escape believing in it; at all events it is quite impossible to explain natural phenomena satisfactorily without assuming its existence. It was imagined at first to be totally distinct from matter; that it had no weight, and offered not even an infinitesimal resistance to any object moving through it. It was opposed by some on the ground that the heavenly bodies moving in it *must* to some extent, however small, be retarded in their motions; and that if so, each planet must gradually approach its sun, and finally fall into it. If the Ether revolved with the planets this need not happen, but we cannot entertain this supposition from the fact that the planets move with different velocities. If we suppose the Ether to pass through the bodies among the molecules, as water passes through the meshes of a net, there must still needs be friction. The keen mathematical mind of Sir William Thompson has come to the conclusion that the Ether does offer some resistance, and that it does possess weight. He calculates that one thousand million cubic miles of it may weigh one pound.

In some of its properties as before mentioned it is opposed to the ordinary laws of matter, and especially in connection with its power of wave transmission. The wave-transmitting power of any sub-

stance depends principally on the relation existing between its *elasticity* and its *density*. The former helps while the latter hinders wave passage. Now as a general rule the elasticity of a solid in relation to its density is much higher than in the case of liquids and gases. But although we are compelled to think of the Ether as a fluid, or infinitely rare gas, yet in its power of wave-transmission it behaves like a solid, which no other fluid is known to do. I must here, perhaps make one or two dogmatic assertions in illustrating this point, which time will not allow me to prove, and which I must ask you therefore to take for granted. If we regard two substances, the densities of which are the same, the velocities with which a wave (say of sound) would travel through them would be proportional to the square roots of their respective elasticities; e.g., if the elasticity of one was represented by the number four, and of the other by sixteen, the velocity of the wave in the second would be twice as great as in the first, i.e., as four is to two. Let me put it in another way; if we find that a wave travels through one medium twice as fast as through another, we know the elasticity of the first is four times as great as in the second, provided of course the densities are the same in each. Well, the velocity of a wave of light through the Ether is more than a million times greater than that of a wave of sound through air. By the above law then the elasticity of the Ether should be at least a million million times greater than of air. So it is said to be; and so far we can easily understand. But another law in physics tells us that the elasticity of a substance is measured by its resistance to pressure. If you have two india-rubber balls, and it is more difficult to indent one than the other, i.e. it takes a greater pressure, then that ball is the more elastic of the two, and if thrown to the ground will rebound to a greater height. Whence even if the density of the Ether were as great as that of the air (it is infinitely less), its elasticity being at least a million million times greater, its resistance to pressure ought also to be a miliion million times greater; i.e. 15 million million pounds to the square inch, which is about the weight of a cubic mile of granite But this reasoning has landed us in an absurdity, for we have already seen, not only that the Ether offers no resistance at all, or one infinitely small, but that by the nature of the hypothesis it permeates the body itself, which air does not. Our earth rolling onward in its orbit at the rate of 66000 miles an hour suffers no retardation whatever. The two properties of infinite elasticity and infinite permeability, both attaching to the Ether, are in fact utterly opposed to each other and cannot be co-inherent in the same body; the more elastic a substance is the less permeable it must be. There is, I repeat again, no substance known to act as the Ether does, none whatever which

while being in a fluid condition possesses one of the most prominent properties of a solid. We are required to believe in a hypothetical substance which refuses to be bound down by the ordinary laws of matter. It looks suspiciously like a demand on blind Faith, which we have more than once been told, is in Science, the one unpardonable sin. Still

> They all do say we must believe in Ether,
>
> And sure, they all are scientific men.

So much for the nature of the Ether. With respect to the movements in it, there are further wonders. As before stated, it is the medium whereby light and heat are conveyed across the stellar distances. Light and radiant heat are now authoritatively declared to be nothing but wave motions, or more correctly I ought to say wave motions translated into consciousness. By one set of waves the nerves of Common Sensation are affected, and we are conscious of warmth; by another the Optic nervous fibres only are acted upon, and we are conscious of light. Between the two is a mere difference of the rate of vibration. I have already said that the Ether is essentially an unquiet sea; it is continually in a tremor, or shivering condition. This is produced in the first place by those motions of the molecules of all material bodies to which reference was made in the first part of this paper. Men asked how our nerves could possibly be affected by the vibrations of the molecules of a body millions of miles away; how did their effect travel across the intervening space? A similar question had been asked with regard to sound, but that was easily answered; it was soon discovered that air was necessary for its transmission, and that sound could not travel across a vacuum. A few simple experiments showed that air was not necessary to the transmission of light or heat, and the Ether was invented chiefly to provide a medium by which they might travel through space. As with sound then, we get waves; not aerial, but ethereal; so minute that vibrations or tremors describes them better. In talking of these we have to deal with high numbers. It is doubtless known to you that when the middle C of a pianoforte is sounded, the string vibrates 256 times a second; the next C above, 512 times, the next, 1025. If the instrument have seven octaves, the lowest note being C, the uppermost note would by caused by 4096 vibrations per second. These may seem very high rates of rapidity, but they quite fade away into nothingness when we come to ethereal vibrations which produce the sensation of light. The lowest number which can affect the optic nerves is 458 billions per second. Once more I ask you not to let this vague number slip by unregarded, but to dwell upon it for a minute for two. Try to conceive of 458 millions of millions

of tiny little waves passing every second through the coatings and humours of the eye without being felt, and then dashing themselves against that delicate curtain at the back of the eyeball, where the fibres of the optic nerve spread themselves out amongst a film of delicate bloodvessels. This is just what happens every time you look at a red ribbon, a ripe strawberry, anything red. Look at the ribbon for one minute and multiply those billions by sixty to see how many waves have struck the retina. A higher rate of vibration gives consciousness of a different colour ; it takes the greatest number to produce violet, no less than 727 billions per second. No scientific man doubts this ; it can be proved mathematically if you will take for granted the existence of the Ether. We know the size of the imagined waves of this imagined substance, which no hnman eye has yet seen ; in red light there are 39,918 to the inch, in violet light 64,631. All space throughout the grand archway of the Heavens is filled with this Ether, vibrating at these and other rates in every imaginable direction. Star-light is but "the transported shiver of bodies countless millions of miles distant, which translates itself in human consciousness as the splendour of the firmanent at night." (Tyndall).

Do these thoughts and figures seem to you impossible of acceptance? They are articles of the Scientific Creed, and as such we are bidden by the apostles of Science to accept them. You and I cannot possibly attempt, each for himself, to find out the probable truth or falsity of any of them. We must be content to accept them at the hands of those who are "honourable men," whom we can trust in these matters because they have made them the study of their lives. We are not expected to refuse belief because they are difficult of comprehension. I ask then on behalf of those who cling to the Old Faith that they may be allowed to do that which every student of Nature and Science is expected to do,—to trust to those honourable men who have made the mysteries of that Faith the study of their lives, and who undertake to explain them only so far as they can be comprehended. If we are told there is no direct proof for any of them, I retort neither is there any for these mysteries of Science ; in both cases (setting revelation aside), we have to depend on the Balance of Probabilities ; the ground of acceptance is as firm in the one case as in the other. The existence of a Creator can be proved in the same way as the existence of the Ether ; we always accept that theory which best accounts for all the phenomena.

There must be "things hard to be understood" both in Revelation and in Science, since it is the same God who is the head of both, and "His ways are past finding out," along whichever path we travel. It is our duty as intelligent beings to explore *all* these

paths as far as we can, and to be content with whatever discoveries we have then made, feeling sure that all will be devoid of mystery some day.

And now with one more observation I will bring this lengthy paper to a close. The language in which some of our beliefs are couched is sometimes said by scientific men to be mysterious in itself, and in some cases unmeaning or even self-contradictory. Well, it may be so, or not. I am not about to defend it, only to say *tu quoque*. What do you think of the following endeavour to account for the twining movements of such plants as the Hop, Convolvulus, and others? Dr. Hooker states that "this twining habit is the effect of an inherent disposition in the tips of all elongating stems to bend successively towards all points of the compass." (*l*). What a lucid explanation! A plant twines round a support because it has a tendency to turn to the north, east, south, and west successively! You will find many of the grand assertions of science as verbal as this.

For simplicity of language let me commend to your notice the following explanation of Evolution. "It is the integration of matter and concomitant dissipation of motion, during which the matter passes from an indefinite, incoherent heterogeneity, and during which the retained motion undergoes a parallel transformation." (*m*). What can you have plainer, or more easy to be "understanded of the people," than that? Or do you feel inclined to regard it as the darkening of knowledge by words? Then listen how the passage has been "done into English" by some one. "It is the joining of stuff into a lump, then the equal unjoining and sending out of movement from it, the making stuff pass from a no sort of unstickingness into some sort of holding-togetherness, while the movement not sent out undergoes a like change from no sort of keeping-togetherness into some sort of sticking."

Some of us perhaps may, after all, prefer the explanation of Evolution by another writer as simpler:—"God said, let the earth bring forth the living creature after his kind." But remember, that is not a scientific way of accounting for it.

Dr. Eastes having made a few remarks at the close, was followed by Mr. H. Blanford, F.R.S., who wished to protest against what he considered a misrepresentation of the views of scientific men. He also spoke at some length in favour of Evolution, bringing forward some very interesting illustrations of it.

(*l*) Macmillan's Science Primus, Botany, p. 33.
(*m*) Spencer's F'rst Principles, p. 396.

In reply Mr. Ullyett, said he had been quite misunderstood by the last speaker, who unfortunately was not present at the commencement of the paper. He (Mr. Ullyett) had not advanced a single argument against any of the scientific theories, but had confined himself to pointing out the difficulties felt by many persons in accepting them. With reference to Evolution, most of the members present would remember that he had invariably argued in favour of it.

A vote of thanks was then passed to the lecturer.

May 15th, 1888.

The first meeting of the Society in the New Museum was held. As the Lecture Hall was believed to be too small for this special occasion, by the kind permission of the Mayor, the large room destined for the Museum itself was used. A varied and extensive collection of objects was exhibited at different tables; among which were :—

Indian Ferns, by H. F. Blanford, F.R.S., &c.
Local Botanical specimens by G. C. Walton, F.L.S.
British Butterflies, by Mr. Austen.
Photographs and other views, by Dr. Churchill.
Ancient and Foreign Curiosities by Dr. FitzGerald.
Local Birds, &c., lately presented, &c. &c.

A large table was set apart for microscopes, and here living and dead specimens were exhibited by about twenty instruments, under the care of Messrs. Horsnaill, Haydon, Howells, Kerr, Peden, Holden, and others.

Electrical Machines were shown in action by Mr. Hambridge, and Mr. A. H. Ullyett.

Under the directorship of the President an orchestral band of ladies and gentlemen helped to make the evening pass still more pleasantly, and refreshments were provided at one end of the room by the committee.

The room was closely crowded during the whole time, and the conversazione was in every respect successful.

October 9th, 1889.

The following paper was read by the President, on

FASHION AND DEFORMITY.

It is difficult to give a short and satisfactory definition of fashion It is, perhaps best described as an over development of the imitative faculties when uncontrolled by the reasoning powers, and it probably reaches its highest development in man and the monkey. Man has been called a "cooking animal" and a "speaking animal," to distinguish him from the lower forms. I would propose yet another definition, and call him a "fashionable animal," as being yet a more distinctive appellation. It would be quite impossible, in the limited time at my disposal, to trace all the varieties and vagaries of fashion in dress, so I shall deal almost exclusively with those which more or less distort the frame or affect

the health. At first sight it would appear too absurd and too presumptuous for anyone to attempt to improve the handiwork of God, and to alter the form he has decreed to his masterpiece—man. But alas! "fools step in where angels fear to tread," and "man, vain man, dressed in a little brief authority, plays such fantastic tricks before high Heaven as make the angels weep to see." Not only are dogs' ears cropped and their noses broken, horses' tails docked and their manes and ears cut short, but even the human form divine is not left in its native majesty. But heads are flattened or distorted, feet crippled, waists compressed, noses and ears pierced, skin tattoed and coloured, and the hair shaved off or tortured into every conceivable deformity, in deference to the blind idol, the relentless Juggernaut of fashion. Not only is fashion followed with a fatuous blindness by ignorant savages, but nations boasting the highest civilisation and culture obey its senseless dictates with a like slavish obedience. The most striking characteristic of the human race, as distinguished from the lower animals. is the erect position and rapid progression in that posture, and it would seem impossible that any people should be so senseless as to interfere with the graceful attributes of walking and running. Yet what do we see? Not only does every civilised nation compress and distort the foot so as to injure it seriously as an organ of locomotion, but the Chinese, who boast a civilisation far older than our own, carry this absurd fashion to such a pernicious extent as practically to deprive their ladies of the power of walking. The object of ambition with a Chinese lady is to possess a foot only 2½ inches long, and this poor distorted member they call the "Golden Lily." The torture a child has to undergo to procure this seemingly small foot is something fearful to contemplate, and yet loving mothers have cheerfully inflicted it on their tender babes for thousands of years, in deference to a senseless custom. Of course this small foot is confined to the upper classes, for it renders a woman utterly incapable of earning her own living, which is doubtless one reason why it is held in such high esteem. It is, however, needless to say it is copied as far as practicable by all classes of women in China. When the child is only three or four years old the torture begins. The tender little foot is freely sprinkled with alum and aromatic gums, and tightly bandaged with a linen bandage about 1½ in. broad, in such a way as to compress the toes and arch them inwards on to the sole of the foot, while the big toe is forcibly bent downwards. After a month or so the feet are soaked in hot water and the bandages taken off, when there is always more or less ulceration, and sometimes one or two of the toes have mortified and dropped off, which is considered a great triumph, as it permanently reduces the size of the

foot. The bandages are then re-applied. I regret to say the same foolish prejudice in favour of a small useless foot prevails in England. A lady complacently told me one day that when she was staying at a country house her shoes were always taken to the nursery. They take them for one of the children's shoes, you know." "Yes," I replied, "the same thing has happened to me. They once took a shoe of mine to the nursery. They took it for the cradle, you know." To get the full power of the foot in walking, the big toe should be parallel to a line drawn through the centre of the foot, and the toe part should expand at least an inch when we bear our weight on it. But which of us after infancy has feet like this? The toes of babies are almost as prehensile as their fingers, and they ought to retain this power, more or less, during adult life It is only in deference to a foolish fashion that we consider small and pointed shoes becoming. In the reign of Henry VIII., broad toed roomy shoes were worn, and no doubt admired.

Although the fashion of altering and distorting the shape of the head does not now obtain among civilized nations, yet it is one of the most ancient and widely spread customs that ever existed, and skulls have been discovered dating at least as far back as the stone age, showing this artificial deformity. Hippocrates, B.C. 400 speaks of a nation whom he calls the Macrocephali, from the size of their heads, who lived on the borders of the sea of Azoff. They considered him the most noble who had the largest head. I wonder if this is the real origin of our term "long headed," for shrewd and clever? The fashion of modifying the shape of the head is very widely spread, and exists in Asia, Africa, and America; now, of course only among more or less savage tribes The prevailing fashion is the conical head, though some tribes prefer the head flattened from the front and back, or laterally. Even in France or England the fashion of compressing the head in infancy with circular bandages has existed within the memory of living men. The prevalence of bald heads is attributed to the wearing of tight hard hats, and in former days to wearing night caps. The usual method of compression is to place the baby's head between two flat boards which are hinged at one end, and gradually to increase the pressure by tightening the side strings. When the fond mother has produced the coveted deformity, she feels she has really done her duty towards her offspring.

From the head to the hair is an easy transition, and as the hair lends itself so readily to all changes, so there is positively no limit to the fantastic tricks which are played with it. With most nations the hair is considered an ornament, and a luxuriant head of hair becoming to a woman. The Fijian ladies,

however, think just the reverse, and accordingly shave their heads quite close, and as this used to be performed with either a sharp flint or the fine edge of a shell, the operation must have been somewhat painful and prolonged, and is a proof of what a price people will pay to be in the fashion. Curiously enough, the men wear the most elaborate coiffeur, which requires great art in building up, and is destined to last a whole life time, thus reversing our idea of the proper fashion for dressing the hair of the two sexes, for men wear the hair long, women short. The men, too, wear a long bone, or wooden pin thrust through their locks, but this probably is not entirely for ornament. Some of the African tribes consider eyebrows unbecoming to a woman, so they are carefully eradicated with pinchers. Just now red hair happens to be in fashion, and many ladies and some savages (notably in the Pacific Islands) convert their naturally dark hair into a tawny red, by means of lime, and other ingredients. I remember the time when red hair was almost a reproach to a woman. Nor can we men boast much, for the way we cultivate, or shave off, or trim, or stiffen, our beards and moustaches, is as unreasonable and capricious as any of the vagaries of female fashion.

One would have thought the teeth, on whose soundness so much of our health and comfort depends, would have been left alone, but various African tribes modify them in every conceivable manner; thus we have teeth pointed, serrated, filed flat and even, or made to show the darker dentine beneath by filing off the enamel. Many tribes consider white teeth extremely ugly (*i.e.* unfashionable), and stain them black or yellow; others not only stain them, but drill holes through them with infinite labour and insert plugs of brass or gold, which being kept bright by the friction of the lips, produce no doubt a very brilliant effect.

There is no fashion more universal than piercing the ears, and inserting various forms of ornament in the aperture. Our ladies have not yet come to wearing nose-rings, though no doubt, they would do it if some English Princess or Parisian notoriety were to set the example. Civilized women moreover do not wilfully enlarge the opening in the lobe of the ear more than necessary for the insertion of a small ring. Now in New Zealand the hole of the ear is gradually enlarged by progressive stretching, until a well-dressed, or tattoed man of fashion can in some instances put his arms through them. Ordinarily they are used as pockets, and pipes, chisels, teeth, and nails of dead relatives, the eyes of a slain enemy, or any little odd trifle of that kind is inserted into them. Some Mexican tribes fill them up with bone or polished wood. The lip is too tempting a part to escape mutilation. Some of the Indians of S. Brazil, insert long plugs

in their lower lips, often weighing two, three, or four ounces, which drag down and overt the lip, and expose the teeth and gums. These plugs are made of polished wood, bone, or agate; the effect to our ideas can hardly be pleasing. Some insert round solid discs of wood or metal, which are gradually enlarged as the child grows. Some of the African tribes (notably the Bongos) treat the upper lip in the same way and gradually enlarge the slit which it is made in it in early life, till it will hold a discs of polished wood or metal as large as half-a-crown; then when the upper lip is quite horizontal, and the lower lip perforated with a large conical plug of hard stone or agate (something like a Belemnite), and the head is nicely shaved or scraped; then and only then the lady considers herself "properly dressed." It is true she has to hold up her upper lip with one hand before she can drink, but that is a small price to pay for adornment. Some tribes consider a large copper ring, such as are used for bulls, a great ornament, and of course we are all familiar with the nose rings worn by Ayahs when they come over from India. I do not know that they are any more useless and absurd than earrings. Some of the Musgoo women wear a clamp or clasp of metal at each corner of the mouth, presumably to lessen its dimensions, an object, to judge from my recollection of African mouths, not altogether unworthy. It is a very curious and interesting fact that so many arbitrary and quite useless customs should be common to races living in different quarters of the globe, and without any means of communication. If it points to community of origin it carries back fashion to a very remote antiquity, when the human race first began to spread itself over the earth's surface, and speaks volumes for the vitality of any custom however senseess when once produced.

It is difficult for a man and a doctor to speak with moderation on the subject of the unsightly and pernicious practice of pressing the ribs and waist, which is in vogue in all civilised countries. I will, however, endeavour to be moderate, as I believe no cause, not even the highest and holiest, is really served by intemperate language. I will endeavour to explain, though I know it will be useless, some of the more direct consequences of compressing and displacing such vital organs as the liver, stomach, heart, etc.; many of the more indirect consequences would require too long a medical explanation, and would be of too technical a nature. Briefly then, the ribs are compressed, and the chest or thorax is so altered in shape that from being like a Λ with base below, it is converted into a V with the base above, thus diminishing its capacity and interfering with the action of the lungs; the liver is displaced downwards. The diaphragm is prevented descending as it should in inspiration, and the heart is thus pressed on and impeded in its action, the soft

walls of the abdomen are bound down, and its capacity seriously diminished, to the detriment of the action of all the important organs it contains. You will perhaps say, why are these consequences not more felt and serious symptoms immediately produced; I answer the practice is commenced so early in life that the organs, with that wonderful adaptability which they fortunately possess, have time to accommodate themselves to the unnatural conditions, but they are nevertheless slowly but surely affected by it, and eventually langour, hysteria, dyspepsia, headache, backache, neuralgia, bad complexion, skin eruption, red noses, and a host of other ailments are produced, and the whole race is gradually deteriorated. Mercifully the stays are taken off at night, so, as most women spend a large proportion of the twenty-four hours in bed, nature has time to recuperate. But enough of medical detail, and let me tell you how stays came to be worn. There was once a cruel butcher, who had a very talkative wife; to restrain her loquacity he used to lace her up in a jean waistcoat so tightly that she could scarcely breathe, much less talk. This cruel practice became after a time, so popular with husbands, that the ladies, in self defence, adopted it as a fashion, and followed it as such ever since. I am not so sanguine as to imagine that any words of mine will have any influence in altering fashion, it is too deeply rooted, and of too unreasonable a nature to be affected by arguments; but if I have succeeded in impressing on even one of my audience the follies of some fashions, and the unhealthiness and mischievous consequences of others, I shall not have spoken wholly in vain.

The Rev. C. Bosanquet, in proposing a vote of thanks to Dr. FitzGerald, defended the practice of wearing stays as supports, and remarked that women were not so bad in this respect as they used to be. He could remember that his nurse used to "creak" when she moved, which was not the case he believed with nurses now.

Dr. Tyson seconded the vote of thanks, which was carried with acclamation.

Dr. FitzGerald in acknowledging it, concluded with a few more rapid delineations of fashion's phases on the black board, and expressed a hope that his lecture would be followed by one on modern dress.

NOVEMBER 18TH, 1888.

Dr. T. Eastes, one of the Vice-Presidents, read the following paper on

BIRDS.

The study of birds is almost an instinct in an Englishman, from peasant to noble an innate affection for the feathered songsters seems to prevail; so that whether it be in a stately aviary or in a little cage outside a cottage door, birds are found to be the constant companions of man throughout the length and breadth of the land, and it is just possible that no other country in the world possesses such a number of birds in proportion to its size, as does Great Britain. Travellers on the continent of Europe often notice how few birds they see, and although they may be there, and may be found by a little searching for, they do not form such a prominent feature of a country walk as they do in our own country. Even the toiler in large towns has but to get a little way into the nearest fields to hear the cheering song of the Skylark or the Thrush, or to be amused with the bustling and active habits of the Starling, or those of the more sedate and cautious Rook. And in a town of the size of Folkestone, we have Starlings, Sparrows, and Robins always dwelling with us, and interesting those who love to watch them. Moralists tells us that a study of the habits of birds will always repay the student, who may see in the feathered favourites which are around him, many a little bright example to be followed if he read the lesson aright. Birds teach us many things—perseverance, fidelity, parental affection, thrift, cleanliness, and many other domestic virtues which are to be seen carried out in their life in the greatest perfection; but I am not aware of any one bird which exemplifies them all at once. Hear what the Rev. F. O. Morris, says about the Dunnock or Hedge Sparrow. "Unobtrusive, quiet and retiring, without being shy, humble and lonely in its deportment and habits, sober and unpretending in its dress, while still neat and graceful, the Dunnock exhibits a pattern which many of a higher grade might imitate with advantage to themselves and benefit to others through an improved example." Some weeks ago the expectant crowds of Folkestone listened patiently whilst the connection between Music and Morals was brilliantly demonstrated to them step by step. Now you have the connection between Birds and Morals shown to you, and I think it is a simpler one, viz. that of example, only let your examples be well selected. The majority of examples given in to night's paper will be rather to be avoided than followed. Again, a talented naturalist writes: "He who is only half at home with nature on this earth of ours

will be able approximately to appreciate the feelings with which the naturalist travels from place to place; wherever he may be he finds friendly forms. For years he has silently watched the interior economy and household arrangements of animated nature, and get he has not seen all; and on this account, he is never in want of employment. Every bird is a personal friend, the old ones he knows almost as well as he knows himself, and the new ones must be studied. How much more is there yet to observe! Rich as he may be in experiences, every fresh ramble brings him fresh mental treasure. The relations existing between him and the bird become each day more and more intimate; he knows the lives and habits of each; when each arrives or takes its departure; where is its abode; how it is made; when it is occupied by a happy troop of nestlings; when deserted. The naturalist knows his friends by their notes, flight and bearing. Every new bird raises his spirits a step higher; every fresh discovery is a step onward in the knowledge of the ways and means of all things. He is indebted to his friends for many a happy hour; their lives are a pattern worthy of imitation."

Here then we may ask—What is a bird? How can a bird be known from all other vertebrate animals? The chief character which distinguishes the class of birds is undoubtedly *the clothing of the body with feathers*. Other characters they also possess but not exclusively. For instance they have the power of flight developed in the highest degree; but there are some birds, such as the Apteryx, the Ostrich and the Cassowary which cannot fly at all; while on the other hand, there are flying mammals, such as Bats, and in a less degree Flying Squirrels, and there are reptiles, which can progress through the air by means of flight. Again, birds *lay eggs from which they produce their young*, but so do many reptiles and fish, so that this cannot be considered a prerogative of the class of birds. Their *bill is hard and sheathed in horn*, but so is that of the Duck-billed Platypus a mammal, and Turtles also have beaks. Most but not all birds build *nests*, and in this they stand almost alone among the higher animals, but still nest-building propensities are developed in many of the Mammalia, in the Lemurs and Mice, for instance—while some fish also build wonderful nests. But all birds, whether they fly or not, are *clothed with feathers*, and this distinguishes the class Aves in the existing state of nature. The majority are specially adapted for flight, and as this is undoubtedly the most vigorous form of locomotion, the greatest muscular efforts being required to raise and sustain a body above the ground and to propel it rapidly through the air, a large development of muscular energy is necessary. The great strain on the circulation of the blood is met by a heart, not only as complete as in the Mammals, but with stronger mechanism

and a peculiar valvular arrangement for propelling that fluid vigorously through the body. Moreover in addition to their lungs, birds possess a singular provision of air receptacles within the body, and these are connected with a series of cavities, also filled with air, which occupy *the interior of most of the bones.* These cavities serve not only to give lightness to the bird's body, but they also assist the lungs in aerating the blood, so that birds may be said to possess a kind of double respiratory system, but this I shall refer to more particularly later on. As birds exceed mammals in the activity of their breathing and circulatory systems, so also they possess a higher degree of animal heat, their temperature ranging from 2 to 14 degrees, F. higher than that of man. This high temperature is maintained by the bird's admirable feather-clothing which being a non-conductor, effectually serves to guard against any sudden variations of temperature in the air to which its body is exposed during its rapid and extensive flights, as well as tempering the usual radiation from the body.

Since then the possession of feathers is characteristic of a bird, let us enquire into the nature of a feather. It is a modification of the skin, just as are the scales of the feet and claws of the toes. Feathers and hairs, scales and claws are all produced out of, and are modifications of the cells of the superficial layer of the skin called the epidermis, and of the deeper layer, the cutis vera, or true skin. As one might expect in the forelimb of a creature specially organised for suspension in, and progression through the air, it is found that the muscles, as well as the bones and joints, of the bird's wing become much modified, as compared with the corresponding parts of other animals. With all our scientific knowledge and mechanical contrivances, we have never yet succeeded in constructing a flying machine. It is a very remarkable fact that Nature has not only long ago solved this problem, but that she has done so in several ways. The flight of an insect, of a bird, of a bat, is equally perfect in its way; but in each case the result is attained by very different modifications in the skeletal and muscular apparatus. The principal resistance that a flying animal has to work against is its weight; that is the force of gravity which, proportionately to its mass, tends to draw it down vertically towards the earth; hence the muscles which are largest and strongest in a bird are those which pull down the wing against the air, thereby raising the body and overcoming its weight. The chief muscle employed thus is the great pectoral, attached at one end to the large keel or ridge of the breast bone, and at the other end to the "humerus" or "arm bone." This great pectoral is generally the largest muscle in the bird's body, and in fact often equals in bulk all the other muscles put together. The anterior limbs do not touch the

ground and the bones which compose them are adapted for carrying the feathers of the wing.

Thus we have the " manus " or hand with the primary feathers attached to it and the primary coverts at their base, the " antibrachium " or forearm with the secondaries attached, and the secondary coverts, medium coverts and lesser coverts at their base, also the humerus or arm bone, and here the ala spuria or thumb with its own proper feathers. The wing is opened out by straightening the elbow and wrist joints, and folded by bending them. This sort of midrib we call the *stem*, and divide it into *tube* and *shaft*. The tube is hollow, it has a little depression at its root where it has grown from its papilla, and a little opening on the under surface where it joins the shaft, by which its cavity communicates with the exterior; the tube is cylindrical, but the shaft rather square on section. On each side of the shaft are the *barbs*. Each barb is itself something like a miniature feather with another series of divisions on each side called *barbules*. Now here is a very remarkable little piece of anatomy, each barbule on the further side of the barb overlaps the next barb, and is rather firmly fixed to it by a series of little hooks, whilst the barbules on the near side, which are in the same way overlapped by their neighbours have no little hooks. The little hooked barbules are found in all the larger feathers, and what are called the contour feathers of the largest of the three divisions of Birds, but not in the fluffy down feathers of this division, and not in any feathers of the other divisions. Cuvier divided Birds into six orders, chiefly distinguished by their beaks and claws.

1. Accipitres, the birds of prey. 2. Passeres, the passerine or perching birds. 3. Gallinoe or Ground birds. 4. Scansores, the climbers. 5. Grallæ, the waders. 6. Palmipedes, the web-footed birds. This division has been thought to depend too much upon external characters which bear a close relation to the mode of life of the birds, and consequently a somewhat different method is adopted, founded on deeper resemblances and differences. Birds are now divided into three great divisions:—Carinatæ, Ratitæ, and Saururæ. Carinatæ, the birds with a keeled breast bone; Ratitæ, with a flat or raft shaped breast bone; and Saururæ, the lizard-tailed birds. The last division is only represented by the fossil genus, Archæopteryx, greek for the "old bird," certainly not caught by chaff, as he existed before the days of that cereal product. The middle division, Ratitæ, contains the ostriches, Cassowaries, and Apteryx, being all species which cannot fly, and about which we shall say no more this evening, but give our attention to the Carinatæ. Let us now look a little more closely into the general anatomy of a bird. The breast bone is not only very much lengthened, but it has this

keel very much developed in the Carinatæ, the better to permit the insertion of the large muscles used in flight, The small bones of the back, vertebræ, are fixed firmly to make the thorax almost immovable, and thus enable the great pectoral muscles to act at the greatest advantage. As the fore limb is used for flying, the beak, the flexible neck, and partly the toes are modified for seizing and holding. As stated before, many of the bones of birds are not filled with marrow as in the mammals, but with air, which is in communication with the lungs. This obviously lightens the weight. In the skull after the great size of the orbit, the most noticeable feature is that it articulates with the first vertebra by only one protuberance or condyle instead of two, which are found in mammals. Then the lower jaw as you see here is not articulated directly with the skull, but this bone called the quadrate bone intervenes. In the spine we have mentioned that the vertebræ of the neck are very movable, and those of the thorax firmly fixed, each region being exactly suited to the requirements of a bird. As to the ribs, notice these hooked processes, which serve to give them still greater firmness, somewhat similar to the hooked barbules in the feather. The chest bone sometimes has deep clefts in its sides, sometimes not. In front of it notice the collar bones or clavicles united to form the merrythought or furcula. Traces of three fingers are seen, and no bird has more than four toes.

In the hind limb we have the hip joint, the knee joint, and what we may call the ankle joint, which is a joint between the two rows of tarsal or ankle bones as found in man, the first row being joined to the leg bones, the second row to the metatarsal or foot bones, this joint being between the two rows. If the leg of a bird is put in the position of perching, the toes are completely bent, chiefly because bending the ankle joint stretches the tendons that bend the toes, and the bending of the knee joint stretches another tendon, which helps to bend the toes. In this way the weight of the body, keeping the knee and ankle joints bent, keeps the toes tightly contracted round the perch, whilst the animal is asleep; another of the beautiful adaptations found in nature. Coming now to the eyes; in all birds except the night birds of prey, they are placed so as to look right and left and not forwards. The eyeball is not globular but conical, the cornea or clear part being a segment of a much smaller sphere than the sclerotic. This sclerotic (the white of the eye) is a strong and firm membrane in which a number of bony plates are developed, and which encloses the more delicate parts of the eye. In the pigeon, which we may take as a good example of the average shape, the sclerotic is much the shape of a kettledrum, and the cornea is like a cannon ball let half into it on its flat side, so that it projects like a bullseye from the centre.

The iris is the circular curtain which regulates the amount of light admitted, and the aperture in it, or pupil is always circular in Birds, and not elongated as in cats. Birds have two ordinary eyelids, upper and lower, and a third called membrana nictitans, or winking membrane, which is drawn over the front of the eye from the inner to the outer side. They have no external ear as mammals have, neither have they lips or teeth in the ordinary sense. The beak or horny covering of the jaws is wonderfully modified in different birds, according to the duties required of it. In many birds the tongue is either feebly developed, or is encased in horn, so that it can hardly be as useful an organ of taste as is our tongue: in the Pelicans it is obsolete. In some birds, however, as in the Woodpecker, it is a very powerful seizing organ, as it is protruded with great rapidity by means of a special muscle, and is well provided with a sticky secretion, which is given off from a large gland, which lying underneath the muscle referred to, is compressed when this muscle contracts; so that in the Woodpecker just as in the mammal called the Great Anteater, the insect prey is easily captured. Many birds swallow small stones which are found in the gizzard and evidently help to do the work of the absent teeth. The lungs of birds must now receive a little attention from us, because of their connection with the air sacs. They are of comparatively small volume, and their tubes or bronchi run nearly parallel to one another, and open by thin-walled tubes into the air sacs. Their lungs cannot be expanded and compressed to at all the same extent as ours, because the chest wall is comparatively fixed, and they have no well-developed diaphragm The air sacs according fo Professor Owen are found in all birds, with the exception of the Apteryx. Our knowledge of their existence is primarily due to our renowned fellow townsman, the great Dr. William Harvey, whose statue we have near Langhorne Gardens, while it is to the distinguished anatomist John Hunter, that we owe our knowledge of the very curious fact that these air-passages and air-sacs communicate also with the cavities of some of the bones of the skeleton. Though these sacs are not by any means highly vascular, or supplied with blood-vessels to the same rich extent as are the lungs, they are nevertheless of enormous importance to the bird, thus: they diminish its specific gravity. Again, the air which is taken into the lungs, is, in high flying birds, of an extremely low temperature, but this air is not only brought into contact with that of the lungs, but also with that which has been warmed in these deep air-sacs. And again, the air is often very dry, as it is for the ostrich on the desert plains of Africa, but the air from the air-sacs contains a large amount of moisture. There are nine air-sacs. Four lie in

the chest, the two anterior, and posterior thoracic. Three are in front of the chest, and two behind it. From most of these, communications are given off to the bones of the vertebral column, to the humerus, to the thigh bones, to the breast bone, and to the ribs. The organ of voice in singing birds is not the larynx, but the so-called lower larynx or syrinx, which is developed where the trachea divides into the two bronchial tubes, and is altogether a strange structure to which some anatomists have given great attention. Some young birds on being hatched are able to shift for themselves, and are covered with down, while others are born naked and helpless, and require food from their parents for some time. Of the former section an ordinary chicken is a familiar example, while a young thrush or a sparrow illustrates the latter. You may, perhaps, many of you, have heard the expression "Pigeon's Milk." For the first three days after the egg is hatched the parent bird feeds the young one exclusively with a milky fluid which is formed in the crop, hence the expression.

Amongst the birds of prey we find that the female is generally a larger and more powerful bird, and it therefore was preferred in Falconry. As to the way in which Vultures discover their prey, the opinion of naturalists has for a long time been divided, and controversy has waxed hot upon the subject, the question being whether the vulture possesses a more than usually keen sense of sight, or whether his sense of smell is so powerful as to enable him to scent a decaying carcase at a greater distance than other birds can do. The experience of various travellers seems to prove that both senses are possessed in no ordinary degree, but that it is by their keen sight that vultures generally find their food. Supposing that an animal is wounded, and escapes from the hunter, his course is marked by a vulture soaring high in the air; another circling far away on the horizon sees the first bird fly down, and follows in his track, and so on, until a large company is feeding on the carcase. This action of vultures is well described in Hiawatha, Book xix.:—

> "Never stoops the soaring vulture
> On his quarry in the desert,
> On the sick or wounded bison,
> But another vulture, watching
> From his high aërial look-out,
> Sees the downward plunge, and follows;
> And a third pursues the second,
> Coming from the invisible ether,
> First a speck, and then a vulture,
> Till the air is dark with pinions."

Canon Tristram, in writing of Griffon vultures, says:—"May we not conjecture that the process is as follows: The bird that first descries his quarry descends from his elevation at once; another, sweeping the horizon at a still greater distance, observes his

neighbour's movements, and follows his course; a third still further removed, follows the flight of the second; he is traced by another, and so a perpetual succession is kept up as long as a morsel of flesh remains over which to consort. I can conceive no other way of accounting for the numbers of vultures which in the course of a few hours will gather over a carcase, when previously the horizon might have been scanned in vain for more than one, or at the most two in sight." A specimen of the Griffon vulture was caught near Cork in 1843 by a boy, and two specimens of Egyptian vulture have been shot in the British Isles, these therefore head the list of British birds. Canon Tristram says again of the Griffon vultures: "They were able to fast for days, but whenever such an opportunity as a camel's carcase presented itself they would be revenged on their fast. I have seen our pet Musha Pasha attack a dead camel, and, as his crop became distended, sink upon his breast unable to stand, till at length, even this position being too much for him, he lay on his side still eating, until, overcome and helpless, he fell asleep." That I should call gluttony. As I said in the beginning of my paper, moralists must be careful in selecting their examples. The strength of this same vulture's stomach was equal to its capacity, for on one occasion it devoured a half pound pot of arsenical soap, and only suffered sickness in consequence. There is a bird of the hawk family, found in Africa, called the Secretary bird, which is very skilful in destroying venomous serpents. It is for this reason protected by various Governments in South Africa. It does not always win the fight. One was observed to suddenly leave off fighting, and run to a pool of water, where it fell down dead. It fights by spreading its wings out in front as a shield to guard its body, and then suddenly assails the snake by a tremendous blow with its feet. If the snake bites a feather, the bird immediately pulls it out; but in the fatal instance mentioned, the snake had drawn blood from the point of the wing. This is a handsome bird, standing more than four feet high, with an elegant crest of plumes on its head.

In the Museum you can see a pair of sparrow hawks. These birds make smaller birds their prey much more frequently than the kestrel, of which Mr. Ullyett has kindly lent me this specimen to-night. I am not quite sure that I have seen sparrow hawks about here lately, but the kestrels afforded me a lot of amusement this past summer. I was on the edge of the chalk cliffs overlooking the Warren, when I heard a peculiar whining cry, like that of a small baby. I looked across to a very steep, prominent, chalky height, and saw three or four kestrels flying about in a very excited way, and screaming. In a very short time I saw a very small rabbit run rather slowly up an almost perpendicular piece of the

cliff, and disappear into a burrow, on which the birds all flew away; but a day or two later I again saw four or five kestrels about the same part. I suppose it was the rabbit that cried, as it seemed a distinct sound from the screams of the birds, and I should say he had a very narrow escape. Kestrels seem very pugnacious. Once in the autumn two hen kestrels rushed furiously at one another, and were so firmly grappled together by their talons that they could hardly be separated when shot dead. On another occasion a male Kestrel ate the body of its partner, which had been shot, and hung in a tree; and a pair of Kestrels in confinement having been left without their supper, the male was killed and eaten by the female before the morning. The way in which the Kestrel, or Windhover as it is called poises itself in the air before falling like a stone upon its prey, is a familiar sight to us all, the outspread tail and quivering wings making it a graceful object, suspended like Mahomet's coffin between heaven and earth. I like to watch the way in which, when the prey has just escaped in time, the bird converts its fall into a rapid skimming movement over the surface of the ground and then rises and again searches for prey. The sudden change in its progress is very gracefully accomplished.

The Buzzard I only allude to, to call attention to these fine spicimens.

Owls form a tolerably distinct suborder of birds, and can usually be recognised without any scientific knowledge, their large heads, short necks, full face, surrounded by a sort of ruff, and the eyes both looking forward are familiar characteristics of their kind. Owls are very interesting from a literary point of view. They were regarded as birds of ill-omen as much by the inhabitants of Greece and Italy in olden times as they have been in England up to the present day, so also in Morocco and W. Africa, and in many Eastern countries. The Athenians alone seem to have had a regard for these birds, and an owl is found on the reverse side of many of their coins, the bird being sacred to their guardian Deity Athene. It is difficult to account for its being regard d as the embodiment of wisdom, unless from its having been sacred to Minerva, the Goddess of Wisdom.

The "Owlet's wing" was an ingredient in the witches' cauldron, in "Macbeth" for their "charm of powerful trouble" and with the character assigned to it by the ancients, Shakespeare, no doubt, felt that the introduction of an owl in a dreadful scene of a tragedy would help to make the subject come home more forcibly to the people who had, from early times, associated its presence with melancholy, misfortune and death. Accordingly we find the unfortunate owl stigmatised as the "obscure," "ominous," "fear-

ful," and "fatal" "bird of night." Its doleful cry pierces the ear of Lady Macbeth while the murder is being done:

"Hark! Peace!
It was the owl that shrieked, the fatal bellman,
Which gives stern'st good-night."

And when the murderer rushes in immediately afterwards exclaiming

"I have done the deed. Didst thou not hear a noise?"

she replies

"I heard the owl scream."

And later on,

"The obscuré bird clamoured the live-long night."

The awe, no doubt, with which this bird is regarded by the superstitous, may be attributed in some measure to the fact of its flying by night

"Deep night, dark night, the silent of the night,
The time of night when Troy was set on fire,
The time when screech owls cry."

And yet, strange to say, the appearance of an owl by day is by some considered equally ominous.

"The owl by day,
If he arise, is mocked and wondered at."

Again,

"For night owls shriek, where mounting larks should sing."

An owl heard at a birth foreboded ill-luck to the infant. Henry VI., addressing Gloster, says:

"The owl shrieked at thy birth, an evil sign."

while upon any other occasion its presence was supposed to predict a death, or at least some dire mishap.

"The screech owl, screeching loud,
Puts the wretch that lies in woe
In remembrance of a shroud."

When Richard III. is irritated by the ill news showered thick upon him, he interrupts the third messenger thus:

"Out on ye, owls! nothing but songs of death."

One large order of birds, Picariæ, from picus, a Woodpecker, contains Parrots, Cuckoos, Woodpeckers. Kingfishers, Goatsuckers, Swifts, and Humming birds, and with a few words about some of these I shall bring to-night's paper to a close. Parrots I shall not say much about, but from their general cleverness and their facility in talking, they are very interesting. It is very easy to be persuaded that these birds think and reason, and the *a propos* or *mal a propos* way in which they introduce speeches, coupled with the look of wisdom which they assume while being spoken to, seem to show that the brain is being employed in thinking. There was a Parrot show in the North of England, where the talking powers of each bird were made the subject of a prize competition. Several of the Parrots had exhibited their prowess, and at last the cover was taken off the cage of a Grey Parrot, who at once exclaimed, on seeing the company to which he was introduced, "By Jove! what a lot of Parrots," and so gained the prize.

The Cuckoo is always an interesting bird to us in England, and known of old as "the harbinger of spring." Wordsworth writes thus :

"Thrice welcome, darling of the spring !
Even yet thou art to me
No bird, but an invisible thing,
A voice, a mystery."

but I don't think we shall have much commendation for the remarkable behaviour of either the old or the young bird as regards their nesting habits. The 17th April is put down as the usual date for his arrival in England. The female lays her egg upon the ground about the middle of May and then deposits it in the nest of a bird whose egg resembles the one she has just laid, for cuckoo's eggs vary very much, and she makes no nest of her own. She may perhaps turn out some of the eggs already in the nest she selects. Morris mentions 22 kinds of birds whose nests are frequently used, bnt the Hedge Sparrow, Robin, Titlark, Wagtail, and Wren are sufficient for me to enumerate. Now the egg of a cuckoo is remarkably small, corresponding to that of a bird about one quarter of its own size, and the young, on being hatched, are sturdy persevering little murderers, even before they can see. Listen to the following, written by a lady naturalist. "The nest was that of the Titlark, and had two Titlark's eggs, besides that of the Cuckoo. It was below a heather bush on the declivity of a low abrupt bank. At one visit the Titlarks were found to be hatched, but not the Cuckoo. At the next visit, forty-eight hours after we found the young cuckoo alone in the nest, and both the young Titlarks lying down the bank, about ten inches from the margin of the nest, but quite lively after being warmed in the hand. They were replaced in the nest beside the Cuckoo, which struggled about till it got its back under one of them, when it climbed backwards directly up the open side of the nest, and hitched the Titlarks from its back on to the edge. It then stood quite upright on its legs, which were straddled wide apart, w'th the claws firmly fixed halfway down the inside of the nest, among the interlacing fibres with which the nest was woven, and stretching its wings apart and backwards, it elbowed the Titlark fairly over the margin so far that its struggles took it down the bank, instead of back into the nest. After this the Cuckoo stood a minute or two, feeling back with its wings, as if to make sure that the Titlark was fairly overboard, and then subsided into the bottom of the nest. As it was getting late, and the Cuckoo did not immediately set to work on the other nestling, I replaced the ejected one, and went home On returning next day, both nestlings were found dead and cold out of the nest. I replaced one of them, but the Cuckoo made no effort to get under it and eject it, but seated himself contentedly

on top of it. What struck me most was this: the Cuckoo was perfectly naked, without a vestige of a feather, or hint of future feathers; its eyes were not yet opened, and its neck seemed too weak to support the weight of its head. The Titlarks had well developed quills on the wings and back, and had bright eyes partially open; yet they seemed quite helpless under the manipulation of the Cuckoo, which looked a much less developed creature. The Cuckoo's legs however, seemed very muscular, and it appeared to feel about with its wings, which were absolutely featherless, as with hands; the spurious wing, unusually large in proportion, looked like an outspread thumb. The most singular thing of all was the direct purpose with which the blind little monster made for the open side of the nest, the only part where it could throw its burden down the bank." After the true nestlings are ejected, for weeks the powers of the foster parents are exercised to the utmost to feed the gaping and constantly complaining occupant. Even when the young Cuckoo has outgrown the rest, and is strong enough to fly about, he is still attended by his foster parents. If a bird is put into the nest that is too large for it to eject, or if the nest is in a hollow it kills it by treading on it, or sometimes after a time of great uneasiness allows it to remain. But after the first few days of its life it does not mind an intruder. If two Cuckoos are hatched in the same nest, there is "war to the knife" until the weaker one is ejected. The reverse side of all this murderous selfishness is seen in the love and attention of the foster parents for their unnatural adopted child. Wrens, Robins, and Titlarks devote thomselves to satisfy its enormous appetite. The Cuckoo makes its winter home at the Cape of Good Hope, travelling by the Nile valley and E. African coast.

I read a strange fact about some brilliantly coloured birds found in Africa—the Plaintain Eaters; their primaries are a beautiful red, and in a violent shower in the rainy season the whole of the brilliant red colour is washed out, and the quills become pinky white, but after two or three days the colour is renewed, and the wings resume their former beauty.

I shall not say much about Woodpeckers, except to call your attention to these pictures, which, I believe, are fairly true, and to the fact that they are typical climbing birds, helped by their long toes, arranged two in front and two behind, and by their stiffened tails. I have already called attention to their tongue, which has minute barbs at the end, and is covered with a sticky fluid; but the mechanism by which it is suddenly thrown out and drawn back is a wonderful instance of special development for a special purpose, though rather too technical for this paper to-night.

The Kingfisher is the most brilliantly coloured bird perhaps in

England, but in consequence of its shy habits and rapid flight is not often well observed except as a passing flash of bright blue. In April the bird makes a hole in a bank, or uses one already made, and makes a nest of fish bones at the bottom of it. But in ancient times its nest were supposed to float on the top of the sea, and there was a legend that when the Kingfishers were making them, fine weather was always allowed to prevail, the water in kindness to them remaining so smooth and calm, that the mariner might venture on the sea with the happy certainty of not being exposed to storms or tempests.

Perque dies placidos hiberno tempore septem
Incubat alcyone pendentibus æquore nidus."
Ovid, Met. xi. 745.

And, through seven calm days in the the winter time, sits the Kingfisher, whilst the nests are floating on the sea.

As the ancient name for the bird was "halcyon" or "alcyon," this period was called by Pliny and Aristotle "the halcyon days," and so Shakespeare

"Expect Saint Martin's summer, halcyon days."

And a Kingfisher used to be suspended by a thread with extended wings in order to show the direction of the wind like a weathercock. In King Lear we have rogues who

"Turn their halcyon beaks
With every gale and vary of their masters."

and after Shakespeare, Marlowe in his "Jew of Malta" writes—

"But how now stands the wind?
Into what corner peers my *halcyon's* bill?

I shall now bring this rambling paper to a close, just saying that I hope at a future time to read another, touching on the more familiar birds that we have about us, such as Robins, Wrens, Titmice, Starlings, Blackbirds, and some of the Finches.

December 11th, 1889.

An exceedingly interesting lecture on the Breathing Organs of Insects was given by Mr. Horsnaill, Secretary to the Dover Field Club. It was illustrated by a large collection of diagrams and specimens, and preparations were afterwards exhibited under several microscopes, kindly brought by Colonel Le Griee, Messrs. Kerr, Peden, and others. A vote of thanks was accorded to the lecturer, and a hope was expressed that the Dover and Folkestone Societies, would be co-workers for the district, and mutual helpers to each other.

Correspondence concerning the Museum.

The following letter was sent to the Town Clerk in consequence of a previous communication remaining unanswered:

April 28th, 1888.

Dear Sir,—(After applying for the use of the large Museum Room for a meeting on May 15th, the letter went on)—I am also directed to ask that the matter referred to about the management of the Museum in my letter of February 27th last may be settled as soon as convenient, as there is an uncertainty about it at present very detrimental to the interests of the Museum. Unless the specimens are *at once* examined and cleaned by some practical naturalist as mentioned in my letter to His Worship the Mayor, and read to the Council two or three weeks ago, I do not think many of them will be left in a fit state for transference to the new building, whenever that may take place.

I am, dear Sir,
Yours faithfully,
HY. ULLYETT, Hon Sec.,
Curator of the Museum.

To the above letter an answer was received stating that the matter would be brought forward at a meeting of the Museum and Library Committee to be held shortly. At that meeting the care of the Museum was formally taken out of the hands of the Society, and the following letter was forwarded to the President.

Town Clerk's Office, Folkestone.
30th May, 1888.

Dear Sir,—I am directed by the Public Library and Museum Committee in acknowledging the receipt of your letter to them of the 16th February last, to inform you that they accept the offer of your Committee to hand over to them the care and responsibility of the specimens at the Museum, High Street, and have appointed a sub-committee for that purpose.

The Committee fully recognise and appreciate the value and

importance of the work performed by your Committee, in token of which I have the pleasure to send you a copy of a Resolution passed by them at their meeting held on the 11th instant.

"That a cordial vote of thanks be passed to the President and members of the Folkestone Natural History Society for the care taken by them of the specimens at the Old Museum, High Street, during the past 18 years, and that a copy of this Resolution be forwarded to the President of the Society."

I am, dear Sir,

Yours truly,

W. G. S. HARRISON,

Town Clerk.

C. E. FitzGerald, Esq., M.D.,
President Natural History Society,
Folkestone.

Folkestone Natural History Society.

Established for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the Summer one or two field excursions are taken.

The subscriptions are of two classes, one Five Shillings per annum, the other Two Shillings and Sixpence. Anyone wishing to join should communicate with the Secretary, at 98, Dover Road, Folkestone.

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SIXTH SERIES.

PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

FOR THE YEAR 1889.

FOLKESTONE:
J. English, Printer, 31, High Street.

FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS.

TWENTY-FIRST SESSION, 1889.

February 12th, 1889.

Mr. G. Haydon, of Dover, gave a very full and interesting lecture on "The Development of Tools and Implements from Pre-historic Times." His address was illustrated by a large number of beautiful diagrams and illustrations, and these were again supplemented by a collection of models and of actual implements from the Palœolithic or Early Stone Period through Neolithic, Bronze, and Iron Times. Modern examples at present in use in India, China, and other places were shown, and these differed in very slight points from those of the early days, and from others depicted on old Egyptian buildings. In fact it was easy for the lecturer to show that the most finished modern iron axe or spear was but slightly altered from those of Neolithic Times. He also dwelt on the curious similarity of the stone and bronze implements found in all parts of the world,—a consequence of the same kind of work having to be performed. Although the material and finish in modern times may rank higher, yet no new principle is involved in the construction; men found out at a very early period the form best suited for each weapon or tool.

The lecture was supplemented by remarks from the Rev. W. Hall, Mr. Blandford, and Mr. Walton. A warm vote of thanks was accorded on the motion of the chairman, Dr. T. Eastes.

March 12th, 1889.

ANNUAL MEETING.

The President, Dr. FitzGerald, in the chair. The Secretary read his report for 1888, as follows:

I am glad on this, the twenty-first anniversary of the existence of our Society, to give what I hope will be regarded as a satisfactory account of our condition. We closed the year with a roll of 99 members, and it will be seen from the Balance Sheet that we have the sum of £16 9s. 6½d. in hand. At the commencement of the year our proceedings were rather irregular, owing to a change in the place of meeting. In March, however, we were able to assemble in the new building, and this meeting proved one of the most successful in our annals. The large room in the Museum was crowded from eight to ten, and the collections and exhibitions of objects proved a source of great attraction and pleasure. Since then four other meetings were held up to the close of the year. All these were well attended, and on the whole much greater interest has been shown in the objects for which our Society was formed.

The care of the Museum has, as most of you are aware, passed out of our hands into that of the Committee appointed by the Town Council, on which three of our officers have been placed. It would be idle to disguise the fact that we parted from it with great regret, having originated it and taken charge of it for nearly eighteen years, through many difficulties, and some little opposition. We trust that those who are to share the fruits of our labours will have all possible success in its future management. I am quite sure that we shall one and all be willing still to render any aid in our power.

Our last lecture in 1888 was given by Mr. Horsnail, the Secretary of the Dover Field Club, and the first in 1889 by Mr. G. Haydon, a member of the same society. This we hope is an earnest of a future union of interests between the two societies. The list of other clubs and societies with which we are in correspondence remains the same as in my last Report.

BALANCE SHEET FOR 1888.

RECEIPTS.	£	s.	d.
Subscriptions	11	17	6
Portion of Mrs. Rumsey's donation drawn from the Bank ...	10	0	0
Interest on ditto ...	1	2	8
	£23	0	2

EXPENSES.	£	s.	d.
Due last year to Treasurer	0	14	8½
Printing and Postage	3	18	8½
Museum Expenses ...	1	10	0
Hire of Room	0	15	0
Conversazione	7	17	5½
Sundries	0	11	2
Collector's Commission	0	11	6
Caretaker (Museum)	0	12	6
	16	10	7½
In hand	6	9	6½
	£23	0	2

Also balance remaining from Mrs. Rumsey's donation of £10.

The President then read the following:

ANNUAL ADDRESS.

Although there have been no great or startling discoveries since I last addressed you, never perhaps have scientific workers been more numerous and indefatigable. Indeed, in reviewing the advance of science during the past year, we can find hardly any branch in which considerable strides of progress have not been made. Electricity maintains the first rank as one of the most practical benefactors of mankind, and from its varied applications is invaluable in the side light it throws on many other scientific inventions, such as the Phonograph, the Graphophone, the new telegraphy from trains in motion, electric fishing, and the production of the valuable metal, aluminium. Sir Frederick Bramwell, in his interesting address last Autumn at the British Association, reminded his hearers that the *object* of that association was primarily the advancement of science in its practical application to the benefit of mankind, and he referred to those physical blessings which science, at the hands of its votaries, has so beneficially showered upon us.

Great astronomical marvels are being displayed by the gigantic telescope at Lick, California, where the Ring Nebula, in the constellation "Lyra," has been under observation. It plainly reveals a corner of the universe, where the great work of creation is now actually in progress. In the cosmic workshop of Lyra are scattered raw materials and finished solar bodies, rows of suns ablaze with pristine light, and masses of unformed vapour, in whose bosom the carbon atoms may be floating, which in time may assume forms of beauty and life."

In France M. Perrotin has been making most interesting obser vations of Mars, in which at one time Libya, a continent greater than France, disappeared beneath a deep blue sea, but which, after a few weeks, partially re-appeared. The lake Ulaeris has also vanished, and a new chann l is visible, running from the Equator to the North Pole, and may be traced right up to its snow-cap.

Messrs. Hutchings and Holden believe that they have found platinum among the metals in the sun; they also confirm the presence of bismuth, cadmium, and silver. The spectroscope, however, by means of which these metals were discovered, does not seem to be equally satisfactory in demonstrating with certainty the existence or non-existence in the sun of the non-metallic elements

Interesting work has been done by Sir Howard Grubb in connection with a clock-driving apparatus, which enables a telescope used for astronomical photography to be kept automatically pointed to the same star, and to follow its apparent motion across the sky. If any error exceeding the fortieth of a second is introduced, a correcting apparatus is brought into action, which brings back the telescope into its required position. He has also introduced a delicate contrivance to allow for refraction, so that the image of a star can be kept perfectly steady and round on the photographic plate for an hour together.

An ingenious machine, designed by Mr. Isaac Roberts, called the Pantograver, has been made to transfer star pictures on a glass negative direct to a copper plate, from which they can be printed without being retouched by hand. From the copper-plate any number of accurate copies can be re-produced for observations and measurements.

Much light is being thrown on the chemistry of geology by the researches of Mr. W. Spring, who has shown that under great pressure copper and zinc filings may be completely amalgamated and so become brass; also lead and tin to form pewter. Sulphides of alkalis and alkaline earths may be similarly formed, whereas it was previously assumed that heat was necessary. He had also operated with moistened substances, under a pressure of 6000 atmospheres—that is, about the same pressure to which the crust

of the earth is subjected at a depth of 70,000ft.—and has found that, with metals, moisture retards the action, but with soluble substances, whose bulk is less when dissolved, the action is quickened. These experiments are of great value when considering the formation of the geological strata, as in the subterranean laboratory of nature pressure is always operating.

One of the three great "Arcana," vainly sought by alchemists, has at last been discovered by modern chemistry. I allude to the "Universal Solvent," the Element Fluorine, which has long been known, but only lately separated, and cannot even now be retained, because it attacks everything. It exists peacefully associated with calcium in Fluor Spar, and in a few other compounds, but when isolated it is a rabid gas. It combines with all metals, and explosively with some, sodium, potassium, calcium, magnesium, and aluminium becoming heated to redness by it. Iron filings and manganese burst into brilliant scintillations when exposed to it—glass it devours at once, and water ceases to be water when brought into contaet with it, the gas combining with its hydrogen and forming hydrofluric acid.

In America the utilization of natural gas is being developed. At Findley, Ohio, a well was bored, which yielded at first eight million cubic feet of gas per day, and as it escapes at the high pressure of 100lbs. to the square inch, it is well adapted for conveyance by pipes to a long distance. In the "Hebburn" Colliery, near Newcastle, a large "blower" of gas, which had been a source of great trouble, is now drawn off pipes and utilised for heating boilers, thus saving both fuel and labour.

A satisfactory method of burning petroleum as fuel has been discovered by Mr. Thomas Urquhart, previous attempts having merely resulted in burning the vapour of the oil. or in turning the oil into a gas and burning that. In Mr. Urquhart's scheme the petroleum becomes by means of a forcible jet of steam or air, a fine spray, which is itself really burned asfuel. The contrivance consists of two tubes, the inner one containing the steam or air, and the outer one the oil, the outer tube being longer than the inner one so that when the air and the oil are simultaneously projected, they combine and are together burned on a fire-brick furnace, towards which the mouth of the tubes open. The minutest particles of oil are in this way consumed, and the fire-brick becomes so intensely hot that it radiates heat to all parts of the fire-box, and serves to rekindle the oil after it has been shut off for a time. A spray producer weighing 40lbs. is sufficient for a locomotive of the largest size.

The development of the Phonograph seems likely to be of great practical use; in its latest form it is capable of reproducing sounds from a whistle to a shout, or from saw-filing to band music. The

motive power is supplied by an electro-moter; the phonogram or message is engraved on a hollow cylinder of wax-coated paper, by the action of a point or style fixed to a glass diaphragm, which vibrates according to the waves of sound. In the reproducing instrument the diaphragm is of silk, also fitted with a style, which traces the exact path of the original style, and, as the diaphragm vibrates accordingly, the same sounds are produced, but with some loss of loudness. The improvement in this Phonograph (Mr. Edison's) consists mainly in the use of the wax covered cylinder, which records much more faithfully the ' timbre " or quality of the sounds than the metal cylinder previously used. The new cylinders measure 2in. in diameter and 4½in. in length, and can contain 1,000 words which are engraved in fine spiral lines; they are so light that they can easily be sent by post, and they possess the advantage over a written communication of giving the words with every inflexion of the voice. A similar instrument, perfected by Mr. Tainter, is the Graphophone, which has the advantage of needing no electro-motor, as it is worked by a treadle. The recording cylinder, as in Edison's phonograph, is of wax covered cardboard, but the diaphragm in the original instrument and the re-producer is a thin piece of mica, in the centre of which is the steel point with which the sounds are engraved. From the simplicity of manipulation with the foot in place of an electro-motor, the Graphophone seems more likely to come into general use than the Phonograph. The head of a firm need only speak into it his correspondence, which can be afterwards written down verbatim by a clerk. It would also be of great service to journalists and reporters, who could leave their articles to be written down by others.

The electric lighting of ships is occupying much attention; the fact of the great weight of the accumulators has been thought a serious objection, but if it can be made to serve as ballast, the weight would even be an advantage. A small dynamo which would charge the accumulator would serve not only to light the ship, but might form a reserve for mechanical power, such as hauling the ropes or weighing the anchor.

Many trials have been made in fishing by electric lamps under water, and in most cases with success. One great difficulty has been that the mains of the lamps have fouled with the fishing lines, but this has been obviated by the use of a lamp worked by a primary battery which can be tossed overboard and recovered at a future time. Last Summer some Liverpool naturalists made an excursion between Liverpool and the Isle of Man, and succeeded in obtaining many interesting objects by means of these submerged lamps, both at the surface and the bottom of the sea. They also experimented by fishing at the same time from one side of the ship,

in darkness, and from the other with the use of the submerged lamps, the result being immensely in favour of the electric fishing, as the nets that side brought in large quantities of fish. The idea is really only a development of the old Norwegian plan of salmon spearing at night with a pine wood fire hung in a cage over the bows of a boat.

Last March an Electric Club was opened in New York, and is fitted up with the latest novelties. "You ring the bell by standing on a metal plate, the door is then unlocked by electricity; chops and steaks are cooked on electric gridiron; boots are cleaned and polished by an electro-motor; the clocks are wound by electricity, and even the club piano can be made to play by this most versatile agent." It has been proposed to let out electric power from central stations to craftsmen at their own homes, and in America, and at Geneva, artizans are already availing themselves of the new energy in carpentering, watchmaking, &c. In St. Petersburgh electricity has been successfully used for slaughtering cattle, death being instantaneous.

Long distance telephoning is rapidly progressing in France, a connection having recently been opened between Paris and Marseilles, a distance of 500 miles. The highest telephone connection in Europe has been opened by the Monks of St. Bernard, between their Hospice and the towns of Proz and S. Pierre, in Switzerland, and Fontine and S. Remy, Italy. In many places on the Continent the "Automatic Machine" has been pressed into the service of the telephone, and by dropping the coin into the slit you can talk with your friends for three minutes. A story is told of an American gentleman, who, by whistling through the telephone, which connects his private residence with his town office, can at any moment summon his dog, who immediately recognizes his master's voice. The greatest advance in telegraphy is also in America, where messages are sent to and from trains in motion.

A new method of photography by artificial light, has been devised by the simple plan of sprinkling some magnesium dust on a little gun cotton, which is placed on the top of the camera on a plate, and then fired at the proper moment by a match; excellent results have been obtained by this process under otherwise hopeless conditions; the flame being large the shadows are not hard as when electric light or magnesium wire is used. Another advantage for portraits is that the eye is shown at its best, the pupil being at its largest in the subdued light previous to the flash, and the photograph being taken instantaneously, the pupil has not had time to contract. So instantaneous indeed is the photograph, that it is taken before the sitter has time to show the startling surprise of the flash in his face; nerve impulse only moving at the rate

of 80 to 100 feet per second, while light travels 200,000 miles a second.

Saccharine, or to give it its due title of "Benzoilsulphonicionide," was at first hailed as likely to be of great use in many departments as a powerful sweetening agent, but many tests have proved that there is little chance of its driving the sugar industry from the field as a regular article of diet. It is prepared from one of the constituents of coal tar, and though in no sense a sugar, it possesses immense sweetening properties, one grain being sufficient to sweeten 70,000 grains of water. It undergoes no change and does not ferment in the system, and is therefore invaluable in some cases of disease; it may also be used to disguise some noxious drugs, having a distinct flavour of its own. It can also be used with advantage in making jam, from its absence of fermenting properties; jam which has been prepared with saccharine is perfectly free from fermentation, though exposed to intense heat, months after its manufacture. On the other hand it has not so agreeable a flavour as fruit sweetened by sugar. Moreover it will never be used for confectionery, from which the maker derives his profit by weight; the quantity and weight of saccharine used in a given quantity of sweetmeats being infinitesimal, whereas the cost has been even greater than that of sugar. One can hardly wish that such a vast field of industry as that of sugar cultivation should be abolished in favour of a substance produced in the laboratory; it would entail terrible loss on thousands of all classes. Lastly the profession to which I have the honour to belong is by no means unanimous as to the benefit of exchanging a nutritive article of diet like sugar, for one which passes unchanged through the body, excepting, as I have said, in some cases of disease.

Another manufacture of possibly great commercial value, is that of artificial silk. M. de Chardonnet has produced this by various chemical solutions filtered and forced by pressure through a fine tubular orifice, and which issue as a semi-solid thread, which, when solidified by the air, may be wound like the silk from a cocoon. The thread is supple, transparent, and silky; it is grey, or black, but can be died. Cotton or other materials covered with a film of this artificial silk, may serve as the basis of beautiful fabrics. I must not leave this part of my address, which will specially interest the feminine portion of my audience, without paying a tribute to their infallible instinct with regard to scientific matters. Sydney Smith defined a woman as "a biped who refused to reason, and who lit a fire from the top." It is, however, conclusively proved that the scientific method of preventing smoke, and economising fuel when lighting a fire, *is* by doing so from the top. In this way the hydro-carbon vapours from the coal pass through the fire above,

and are there burned with a full supply of oxygen, and no smoke is generated. Herr Hempel, in following out this idea, has found that the most effective way of evaporating liquids, is by applying heat above instead of below their surface. He uses a "Siemens inverted gas burner," bringing the flame as near to the surface as possible; there is no ebullition, and consequently no spirting, a great advantage in chemical operations.

A useful application of a well known substance, is that of using Asbestos for firemen's dresses; this is already done in Paris, and is to be introduced in London. In England, Asbestos has been employed for fronting a stage fire-proof curtain.

The metal of the future appears to be Aluminium, to the production of which so much attention is now being directed. It is a most valuable alloy, one tenth added to the weak metal, copper, gives it the strength of steel, while one tenth per cent. added to molten wrought iron renders the metal instantly quite fluid, and makes intricate castings comparatively easy. Should Aluminium continue to progress towards cheapness, it will take the place of copper, tin, or iron, for many domestic uses, being three and a-half times as light as copper, and four times as light as silver.

In Sweden a new glass is being made, of which phosphorus and boron are constituent parts; it possesses such highly refractive power that it is expected to have marvellous results in increasing telescopic and microscopic powers.

A new and promising industry has been started by Professor Schmidt, at Gratz, namely that of sponge growing. He has found that small specimens planted in favourable situations, develope in three years to large and valuable sponges. 4,000 such specimens were produced at the cost of 225fr., or one half-penny apiece.

To turn to another field of beneficial science, M. Pasteur has been called by the people of Australia to the rescue from the plague of rabbits with which the country is now overrun. His plan is to sprinkle chicken-cholera broth over the herbage which the rabbits eat, in the hope that they will take, and then propagate the infection, which will wholly or partially destroy them. The project sounds well, providing the poultry and sheep abstain from this seasoned pasture, but M. Pasteur declares the latter to be proof against this particular infection. Should M. Pasteur succeed his reward will be £25,000.

At Odessa some successful experiments have been made by Dr. Gamalia, in inoculating Merino sheep against cattle-plague.

The French Drs. Roux and Versin are still prosecuting their researches as to the diphtheritic microbe, and they confidently hope to find a vaccine against that terrible disease.

A most interesting operation in beneficial surgery has been per-

formed upon Professor Fleischl, of Vienna. His right hand, which was poisoned 16 years ago, and which from successive operations had lost the use of two fingers, has had transplanted into it "as long a piece as possible of the sciatic nerve of a dead but still warm rabbit," and it is affirmed that the result is most satisfactory.

An interesting demonstration of the power of the retina to absorb light has been made by directing the eye for some time on a bright light, and then turning the eye to a camera, when an accurate photograph of the object gazed at was obtained. The phosphoresent gleam of a cat's eye in the dark is probably due to the same cause, *i.e.*, the light absorbed and stored up in the retina.

A valuable anæsthetic is likely to be obtained from the ancient mandrake, the "mandragora" of Shakespeare. Dr. Richardson procured with some difficulty a root, from which he prepared a wine according to the old recipe. The effects were so potent that his lips to which he touched it, retained insensibility for an hour after. If the alkaloid or active principle were separated, it would doubtless prove a valuable anæsthetic from the long duration it causes of local insensibility.

From time to time we hear of the establishment of the new language of "Volapuk." which from its having the merit of being a phonetic language is destined (so we are told) to become the universal tongue. If, however, a thorough spelling reform such as Ellis's or Melville Bell's, could be made in our own language, there is no doubt that English would in time become the medium of communication between all nations.

Among the scientific discoveries of the future, none will be a greater boon to mankind than the proper ventilation of the crowded alleys and courts of our great cities. A plan has been suggested by that "veteran guardian of the public health," Sir Edwin Chadwick, to erect in densely populated parts huge towers which should bring down a continuous stream of pure air into the noxious atmosphere of our streets and alleys. Whether this plan will ever be carried out, or whether it will share the fate of a former scheme of the "veteran knight" remains to be proved. I allude to his idea some years ago of inventing a hygienic hat, as a substitute for the regulation "tall hat" and which "should combine the comfort of a night cap with the functions of an umbrella."

Undoubtedly the most interesting and even sensational event has been Mr. Norman Lockyer's bold and ingenious theory of the constitution of the Heavenly Bodies, a theory which, if finally accepted, must profoundly modify our views of the structure and evolution of the Universe Briefly stated his theory is that "All self-luminous bodies in the celestial spaces are composed of meteorites or masses of vapour produced by heat brought about by condensation of

meteor swarms, due to gravity." Now meteorites are the only tangible connection we have with "Cosmos" or infinite space; we know they are fragments, messengers if you will, from other worlds than ours, and though few survive the rush through the earth's atmosphere, yet a certain proportion reach the surface undissolved or unvaporized, and can be submitted to chemical analysis. For more than twenty years comets have been held to be clusters of incandescent meteorites rendered luminous by collisions, and we all know that the earth passes through two closed rings of meteors every August and November, but we have now to grasp the idea that infinite space is packed with meteors in unimaginable numbers, flying about with immense velocity in all directions. To quote Mr. Lockyer: It is well known that observations of falling stars have been used to determine roughly the average number of meteorites which fall on the earth each 24 hours; and having this datum to determine the average distance apart between the meteorites in those parts of space which are traversed by the earth as a member of the solar system. Dr. Schmidt, of Athens, from observations made during 17 years, found that the mean hourly number of luminous meteors visible on a clear moonless night by one observer was 14, taking the time of observation from midnight to 1 a.m.

"It has been further experimentally shown that a large group of observers who might include the whole hemisphere in their observations would see about six times as many as are visible to one eye. Professor H. A. Newton and others have calculated that, making all proper corrections, the number which might be visible over the whole earth would be a little greater than 10,000 times as many as could be seen at one place. From this we gather that no less than 20 millions of luminous meteors fall upon our planet daily, each of which in a dark clear night would present us with the well-known phenomenon of a shooting star.

"This number, however, by no means represents the total number of minute meteorites that enter our atmosphere, because many entirely invisible to the naked eye are often seen in telescopes. It has been suggested that the number of meteroites, if these were included, would be increased at least twenty-fold; this would give us 400 millions of meteorites falling on the earth's surface daily. If we consider, however, only those visible to the naked eye, and if we assume that the absolute velocity of the meteors in space is equal to that of comets moving in parabolic orbits, Professor H. A. Newton has shown that the average number of meteorites in the space that the earth traverses is (in each volume equal to the earth) about 30,000. This gives us a result in round numbers that the meteorites are distributed each 250 miles away from its neighbours.

"If, then, these observations may be accepted to be good for any part of space, we may, and indeed must, expect celestial phenomena which can be traced to meteorites in all parts of space.

"In spite of the difficulties which attend the observations necessary to determine the velocity of meteors entering our atmosphere, many observations have been made, from which it may be gathered that the velocity is rarely under ten miles a second or over 40 or 50. It is known that the velocities of some meteor-swarms are very different from those of others. Professor Newton, our highest authority on this subject, is prepared to consider that the average velocity may be taken to be 30 miles a second."

Thus meteorites are as far as we know the most universally distributed bodies in space, and may reasonably be expected to play no inconsiderable part in the economy of nature. We must remember, too, that as the whole solar system is in perpetual onward, as well as rotatory motion, the earth can never twice occupy the same space; so it is fair to suppose that every part of infinite space is equally full of meteorites as that we have already passed through.

The existence of enormous numbers of meteors pervading space being proved, their tendency to collect in swarms within which the tendency to collision will be greater than in the surrounding space may be taken for granted; what then would be the effect of such collisions. Here again, I will quote Lockyer's own words: "The question of what must happen to the meteorites themselves in consequence of this system of collisions is worth going into thoroughly.

"As 30 miles per second is a very frequent value obtained for the velocity of meteorites when they enter our atmosphere, it is possible to compare temperatures brought about by collisions with those produced by passage through our atmosphere. Two masses of meteoric iron meeting each other in space would probably, if moving with a certain velocity, be formed into a pasty conjoined mass, and this process might go on until an iron of large dimensions was formed, and the various meteorites thus welded together would present in time a very fragmentary appearance. While irons were thus increasing in size, collisions with smaller meteorites would be attended with very local increases of temperature, perhaps sufficient to volatilize the surface or allow it to be indented, and in this manner the well-known "thumb marks" receive explanation.

"These operations of nature might go on either in free space, or in the head of a comet, or in meteor-swarms. They probably cause the appearance of the so-called new stars, and in these various circumstances the rate of subsequent cooling would of

course be very different, so that the results would be very different indeed.

"Large masses on collision probably destroy each other, produce fragments and vapour, which again condense. The heterogeneous structure is thus to a certain extent explained."

Here we get the birth of the meteorite, or rather, of new meteorites, for we are of course still as far as ever by this theory, from the origin of the primordial meteor. What then is the heat evolved by collisions at such enormous velocities? It is almost inconceivable. Mr. Lockyer tells us: "If we take these velocities as representing what happens in other regions of space, and assume the specific heat of the meteorites to be 10, the increase in their temperature when their motions are arrested by impacts will be roughly as follows:—Velocity one mile per second, 3,000deg. C.; ten miles per second, 300,000deg. C.; 20 miles per second, 1,200,000deg. C.; 30 miles per second, 2,700,000deg. C.; 60 miles per second, 10,800,000deg." It is evident the heat evolved would be sufficient to account for all celestial phenomena of a luminous character, and would produce a temperature which would be utterly impossible to approximate in our laboratories. It is by this theory Mr. Lockyer accounts not only for comets and nebulæ, but for variable stars, such as Sirius and our own, and dark planets like our earth. He tells us, in fact, that "the existing distinction between stars, comets, and nebulæ rests on no physical basis."

As the meteors draw nearer by the force of gravity into denser and denser swarms, the collisions become more and more frequent and violent, until the acme of heat is reached, producing such masses of incandescent vapour as Sirius, after which comparative cooling would take place, under the influence of which suns of the second class of incandescence, such as our own sun, would be produced. This is well illustrated by a diagramatic curve, which I will reproduce on the black board, showing at the ascending base sparse meteors, gradually drawing nearer and nearer and becoming more dense at the apex, then as gradually cooling as they reach the opposite descending course where cooling and condensation are comparatively complete. Such is the theory in barest outline, and the idea is at least a grand one. Given the two conditions, the existence of meteors through space, and the cumulative force of gravitation, and all the rest follows. But if meteors collide, may not the larger heavenly bodies do so also? May not suns and planets such as our own world, come into disastrous collision? Mr. N. Lockyer tells us that in recorded time there has been no such a thing as "a world on fire," or the collision of masses as large as our earth, but he adds somewhat ominously, "but the distribu-

tion of meteorites throughout space indicates that such collisions may form an integral part of the economy of nature."

In spite of all the advances of science many problems still remain unsolved, such, for example, as how to utilise the enormous power of the tides, how to better preserve animal substances, how safely and effectually to light and ventilate mines, how economically to apply electricity to house-lighting, the proper disposition of the sewage of large towns; these any many other questions still remain unanswered. Looking back on the progress of the last 50 years, however, it seems probable that in the lifetime of many here present science may triumphantly achieve not only these tasks, but many yet unthought of marvels.

After the usual vote of thanks the meeting then proceeded to the election of officers. The President and Secretary were re-elected; also the Vice-Presidents with the addition of H. F. Blanford, F.R.S.

The following Members were chosen on the Committee:—

G. C. Walton, F.L.S. — R. Kerr, F.G.S.
A. H. Ullyett, F.S. Sc. — Rev. W. Hall, M,A.
Rev. C. Bosanquet, M.A. — Mr. Sawyer.
Mr. Knight.

April 9th, 1889.

Mr. J. W. Stainer gave a lecture on the Structure of the Heart in the various divisions of the Animal Kingdom, which he illustrated by diagrams and some admirable sketches on the black board. The attendance was good.

The Secretary proposed, and the Rev. W. Hall seconded, in complimentary terms a vote of thanks to the lecturer.

May 14th, 1889.

Mr. G. C. Walton, F.L.S., read the following paper

ON LICHENS.

The writer of this evening's paper wishes to lead his hearers not over beaten-tracks, but along pathways too little frequented by botanists themselves. Many persons, who, as the saying runs, are "very fond of flowers," do not care much for those plants which produce no calyx, no corolla, no real fruit, and consequently no seeds enclosing an embryo or rudimentary plant. *Cryptogams*, as botanists call these

flowerless plants, are very much more numerous than flowering plants. Great numbers of them are very small, so small indeed, that, but for the microscope, their very existence would never have been known. Others, such as tree ferns, really reach the dimensions of small trees, and are highly ornamental, but our own country produces nothing in the way of cryptogamic vegetation taller than common brake or bracken. That which, in a way, represents the *seed* of flowering plants in the *spore*, and this tiny thing often gives rise to the new plant by a very round-about process. It will bring us, by a few interesting steps, to the subject of this evening, if we look at the list of cryptogamic families and arrange them "in order of merit," or, in other words, give them rank according to their structure. The presence of wood (fibro-vascular bundles), places the Filices, Equisetaceæ, and Lycopodiaceæ, above those orders which are made up of *cellular tissue only*. Again, those orders which, although made up wholly of *cellular* tissue, present a *distinction of parts* are higher in the scale than those which do not. Last, then, come plants made up of *cellular* tissue, but consisting of a network of *threads*, or a more or less *leaf-like* expansion, called a *thallus*, and not having root, stem, or leaves distinguishable from each other. The thallus-producing plants are called *Thallogens* or *Thallophytes*, and constitute what used to be called the orders Algæ, Lichenes, and Fungi. [You will bear in mind that a mushroom is not the plant proper, but only the fructifying apparatus, the vegetative portion (mycelium) called *mushroom spawn* and composed of a network of threads, being underground]. Agreeing in certain points, as in the absence of *stomata* and in not developing a *prothallus* in germination, these orders differ from each other a good deal—at least in their higher forms. Fungi are much lower in the scale than Algæ, because they contain no *chlorophyll* and are therefore unable to take up and assimilate gaseous food. *Chlorophyll does* occur in Lichens, but only in certain small cells, known as gonidia, and usually abundant in what is called the gonidial layer. In the eyes of the student these chlorophyll-containing cells are of great importance, because over them rages chronic war. They are indeed a battle ground on which is now being fought out the question as to what Lichens *really are* and what they are not. The ablest men are to the front in this scientific campaign, the real nature of the *gonidia* being "the question in dispute." Schwendener, following up the researches of DeBary, about 20 years back, took out his position thus—*Lichens*, said he, are not simple but composite organisms—they are not an autonomous group at all, but dual growths, neither one thing nor the other but a mixture. Their gonidia are neither more nor less than so many simple green or greenish-blue *Algæ*, whilst the other portions

of the plant are neither more nor less than a fungus which has seized upon the Algæ (a colony of them), made slaves of them, and indeed, established itself upon them as a *parasite* ! But you will be eager to know if this teaching, this Fungus-alga theory, as it is called, rests upon any well-ascertained facts. In brief the evidence is this. Many fungi produce their spores in little asci or thecæ or sporangia, and are called *ascomycetous*, *ascosporous* or *thecasporous*. The spores of *lichens* are produced *exactly* in the same manner, and have *no connection* with the *gonidia*—therefore they appear to belong to the Fungus. Again the gonidia are said to be *real Algæ*, some of them well-known to exist quite independent of the Lichen thallus. Mr. Crombie, one of our ablest Lichenists, vigorously supports his favorite plants in their claim to independence. In maintaining that a lichen *is* a lichen and *nothing else*, he speaks of the Fungus-Alga theory (hypothesis) as "the romance of lichenlogy." He reasons strongly, and seems to prove that the gonidia, though *like* certain Algæ, are not *identical* with them, and further, that the gonidia really have their birth within the cellules of that part of the plant known as the *cortical layer*. He deals with several other difficulties that confront the Fungus-Algæ theory, but still the new creed gains ground, and is looked upon as the correct thing, for it finds a place in the most recent works of English and other authors. Now, though *we* cannot settle any knotty questions, we may learn something, by looking at a cross section of a lichen thallus, say a leaf-like one. There are three layers to be seen, namely, a *cortical layer* (just referred to) of cells with thick walls, then a layer containing a good proportion of gonidia, and then, underneath, a mass of long thread-like cells (called hyphæ) from which false *roots* (rhizinæ) proceed. Lichens agree with their allies in not needing *true* roots, for it is chiefly the *attachment* they require. The noteworthy point in our section is this—the *gonidia do not appear* to be in real union with any other portion of the thallus, and but few men have asserted that there ever *is* such union between them and the so-called Fungus threads (hyphæ). Crombie's great point is that such organic connection between them and the *cortical* layer *did* exist, and was evident enough in the early stages of growth. If he is not accurate *here*, then the men of the modern theory may have a primâ facie case, but they must accept as one of their "articles" something that has no parallel anywhere in nature, and it is this—that tins cells work hard and maintain a great amount of life that "hangs on," not only without being destroyed, but even with great advantage to themselves. Crombie tells you that in all ordinary cases a fungus will either wound or slay the plant it lives upon, but the Fungus-Alga men find here a great exception to the rule. Professor

Drummond, in his striking and well-known book, "The Natural Law in the Sp ritual World," might have given us a chapter on *parasitism* in its relations to the interesting subject now before us.

Examine a lichen—a *fertile* one—and you will see some little plate-like bodies, sometimes with a thickish margin and sometimes without, sometimes of the same colour as the thallus and sometimes of a different one. These are the *apothecia*—the so-called fructification—which contain the *asci*, along with certain threads called paraphyses. The asci may be likened to a row of tiny soda-water bottles turned upside down, and containing spores. These latter are splendid microscopic objects. Their number is constant in the same species, and is usually *four* or a multiple of four—very often eight. There may, however, be only one, and there may be over a hundred. In their form there is the greatest *variety*. They are not commonly *one*-celled, as they are very apt to double their number by each one dividing into two, and, as the case may be, they are said to be 2,-4,-6,-8, or multi-septate. They require rather a high power—say 400 diameters—with your microscope, but they are amongst the most interesting of objects, and wonderful enough to be warmly commended to the notice of any Microscopical Society. The idea that a *spore* is always a tiny round *simple cell* is quite a mistaken one, for, in its numerous forms and variety of colours, it delights the student. On the surface of the lichen-thallus, generally at or near the margin, are little blackish spots called *spermagones* which contain *spermatia*, and are *supposed* to fertilize the spores of the apothecia. The Spermatia are exceedingly small, and not provided with any *cilia*, so that they do not resemble *zoospores*, which can, for a time, move about freely. Dr. M. C. Cooke, in his "Introduction to the Study of Microscopic Fungi," has a very good chapter on spermagones. Speaking of the discharge of the spermatia from the spermagone he says—"to compare minute things with gigantic, as a recent author has observed, it resembles the lava issuing from the crater of a volcano." Bear in mind that spermagones are not *peculiar* to lichens and that they are commonly but not always found on the same thallus as the apothecia. Some lichens have neither apothecia nor spermagones, but are more or less covered with *soredia*—powdery heaps of *gonidia* they are—and by means of them the species are reproduced. This is a genuine illustration of *vegetative reproduction*, for the old plant throws off part of itself to form its like as many plants, for instance one of the Garlics common on our cliff, throw off *bulbils* to continue their species.

Any lengthy remarks on the classification of lichens would be out of place this evening. Nylander, De Bary, Tulasne, Acharius, Leighton, Crombie, Fries, (and others), have performed the difficult

task of arranging the plants they have so thoroughly studied. Some Lichenists believe in *chemical* re-actions as a means of telling one species from another. They touch some part of the thallus with solution of *chloride cf lime* or strong *solmtion of potash* or *solution of iodine*, in the hope that their re-agent will "give" a yellow, a red, a blue, or purple, a brown, or something satisfactory in the way of evidence. Unfortunately, the same species may have two sets of behaviour, and it is not surprising that it should be so. Chemical tests, if reliable, would certainly very easily and quickly settle questions which require close and painstaking study, but they can hardly be held to be sufficiently reliable. Still, as confirmatory evidence, they are no doubt of *real value*—indeed are almost indispensable, because *descriptions* are barely sufficient when two small species are very much alike. It is believed that Chemistry has an important place in the examination of the lower plants. Where do Lichens *live*? Let us rather ask "where do they *not* live?" They are indeed the very outposts of vegetation, and are very widely distributed from the Tropics to the extreme north. Fries has reported upon species from 83deg. north latitude. In the most inhospitable regions where no other plants will grow these lichens are found coating with their thin or powdery crust, large extents of rock and soil. These encrusting lichens are in many cases too thin to be cut off, so that to obtain specimens it is necessary to break off portions of the rock. A glance at the rocks and walls of our own town will illustrate this to our entire satisfaction; but please do not begin your study amongst these *small* plants unless you are fond of up-hill work. The fact is that many of the lichens found on our walls in towns are small of their kind, consisting chiefly of those *apothecia* already spoken of, the thallus being almost absent. If you would have something *to look at* or, in correct language, if you would find *leafy* or *shrubby* species, you must leave the smoke of towns and go where the air is pure, for lichens will not grow where the air is not up to the mark. This is so true that the lichen collector knows fairly well what kind of district he is in by the harvest he is reaping. He knows that his specimens will be stunted and poor if the air is impure. This fact points out the difficulty that besets any attempt to cultivate these very *particular* plants. Their cultivation has, as might be expected, been attempted, and especially for the purpose of settling if possible the knotty points before mentioned. Only partial success has been met with. Now let us proceed a step and ask what our plants *grow upon* and what they *live upon*. To settle the former part of the question is very easy, as you may find the next time you take your "walks abroad" if you look at the trunks and branches of trees, the stems of perennial shrubs, the palings, the stones, and even the

ground, and the moss growing on it. Notice how very convenient it is to have ever so many different species on the same tree trunk. First admire the *shrubby* kinds and then look at the spreading *leafy* ones, then look more closely, through your magnifier if you like, at the host of apothecia of the *encrusting* or powdery species. You will, unless the writer is out in his reckoning, soon be of an enquiring turn of mind, and will be asking yourselves questions "What is this *white* lichen? What is this *black* one? What is this *greenish*-grey or this *bluish*-grey one? What is this bright *yellow* one? What is this one on the smooth bark of holly and other trees that looks like *scribbling* done by the hand? What is this thickish *gelatinous* plant and what the one that spreads its elegant thallus over the grass at our feet? Your queries must remain unanswered as far as this evening's paper is concerned, and you must remember that success will wait upon patient application. Let us now have a tiny chapter on the *food of plants* as far as the subject bears upon lichens. What *is* their food? Remember how other thallophytes manage matters. The Fungi, in the main, live upon *decaying* vegetable matter, and the sea-weeds live upon the substances *dissolved* in the water. These are accepted facts. Lichens no doubt get nearly the whole of their wants supplied by the rain water which they absorb through their *whole surface*. Some, perhaps are not entirely guiltless of parasitism, but they certainly are not as a group parasitic plants, like the mistletoe, neither do they live upon air—that is to say—they are not epiphytes as many *orchids* are. Finding *air* somewhat unsatisfactory as diet, they fall back upon water with its dissolved contents. A simple experiment proves that they absorb water through their *whole surface*. Distilled or *pure* water cannot minister to the needs of plant life, as *rain* water can do, because of the *dissolved contents* of the latter. What wonderful processes are carried on in the cells of living plants! For plant life generally, certain *elements*—notably *iron*—are absolutely necessary, and certain compounds are very valuable as plant food, but the processes dependent upon life are wrapped in mystery, and are not to be understood even by the most careful experimentalist. Clearly, lichens are well skilled in the art of building up complex compounds out of the elements of a very plain diet, although, as already pointed out, the gonidia are the only cells that contain *chlorophyll*, which is so much concerned in the preparation of plant food. A viscid substance resembling Gum Arabic, and called Lichenine, is freely formed, and the presence of this explains why a decoction of Iceland Moss is quite thick. This decoction is one of the simple remedies, well known, but, perhaps, beaten off the field by more recent competitors. Lichens furnish food for man and beast, and in regions where, without them, there

would be no food. In waste districts of Africa and Western Asia the edible lichen, *Lecanora esculenta*, or "manna of the desert," is of great value as food for man and beast. Several near relations of this plant—that is to say, several species of *Lecanora*, are to be found in our own neighbourhood, but they are not at all like their more useful brother. The desert manna is said to be never *attached* to anything, so that it must live almost entirely upon air. The dyer uses several lichen-products, such as litmus, archil, cudbear. They are not exactly obtained *from* the plants but rather *prepared from them* by the action of certain chemicals. The litmus referred to is the substance from which are obtained the blue solution and paper which the chemist uses as a test. Beginners in chemistry will remember that acid solutions change the blue colour to red. The use of chemical processes in obtaining the dyes seems to favour the idea of chemical tests as a means of distinguishing one species from another. In Lapland, the "Iceland Moss"—pray let it be called Iceland *lichen*—and the "Reindeer Moss" (lichen), are simply invaluable, the latter being used as food both by the reindeer and by man. The Iceland Moss (Cetraria islandica) is abundant in North Britain, and the Cladina rangiferina (the Reindeer Moss), even reaches the southern counties of England, being abundant upon heaths in some parts of our own county, though not occurring very near Folkestone. *This* neighbourhood is *good* for the lichen collector, as it is well known to be for the field naturalist generally. As there are grasses that grow in the sea, so there are inter-tidal species of lichen, but none have been observed on this coast. It is known that fungi cannot do with *sea water*, and this fact goes against the Fungus-alga theory. Generally speaking, lichens are not looked for in wet places at all, although they might be expected to abound there if the holders of the fungus-alga theory have truth on their side. But why, some enquiring member of this meeting may ask, should not plants that live *upon* water live *in* water—why should they not be submerged or floating aquatic plants, and so be sure of constant supplies? This question brings out facts of great interest, and which do not apply to any other class of plants, for the truth is that lichens live a life of a very peculiar kind. They grow fairly fast for a time and then move *very slowly* indeed, clinging to life through long periods of drought and under conditions that would be fatal to plant-life generally. Associated with this power of resistance, is *length of days* for it is startling to record that lichen life is not to be reckoned by hours (as with some *Fungi*), days, weeks, months. or even years, but by tens, and even, we are assured, hundreds of years. In hard times, it is very sluggish, the plants "holding their own" bravely until better times come, when they revive and look young again. The

writer was much interested last winter in noticing a tree which was well clothed with lichens. Half round there was a thick coating of snow, and, under this, the lichens were fresh and well-coloured, whilst those exposed to the dry and cold wind were very withered looking or powdery. It is by the crumbling away of the thallus that the *gonidia* are set free. The terms " annual " and " biennial ' can have no application to lichen-life, which is seen to be so truly *perennial*. It is by a powdery disintegration that the thallus is eventually destroyed, but which of the many species now known hold out longest it is not possible to say. It is, however, known that some of our common species require many years for the production of their so-called fructification. The winter finds the botanist plenty of work amongst the lichens as well as the mosses, so that they who wish to study vegetable life can find plenty of material *all the year round*. Surely these humble plants—these lich'ens or li'chens—to which your attention has been called this evening, are *interesting* things. Poets may not have sung their praises, and thousands of even eager botanists, in their search for other plants, may have passed them without any misgivings, but they have their charms, and, indeed, their special " points " are of quite exceptional interest.

Dr. T. Eastes presided. A large number of specimens were shown, and illustrations given on the blackboard. A short discussion afterwards took place, in which Mr. Haydon, Dr. Morris, and others took part. The attendance was good.

Dr. Fitzgerald was able to confirm, from actual observation, what had been stated as to the occurrence of lichens in very high latitudes.

June 22nd, 1889.

A ramble in search of orchids took place on the slopes of Castle Hill in the afternoon. The attendance was very small. Specimens of Orchis maculata, O. pyramidalis, Gymnadenia conopsea, Ophrys apifera, and O. arachnites were gathered. The Secretary gave a brief description of the fertilization of orchids, as illustrated by the specimens gathered.

A field day was arranged in August at Sandling Park, but as only four or five members sent in their names, it did not take place.

October 8th, 1889.

The Winter Session was opened at the Lecture Hall of the Museum. The weather was very tempestuous so that there were only nineteen present, six of whom were ladies.

On the table were collections of autumn fruits and a few flowers, which were described by Mr. Walton. The most interesting was a collection of fruits of some Cratœgi, brought by Mr. Billinghurst.

In the absence of the President, who had been called away to Tunbridge Wells, but had forwarded a lecture, the chair was taken by Dr. T. Eastes, V.P., and the Secretary read the paper, which treated chiefly of museums and their management, and of mimicry. It was as follows:—

The commencement of the winter session in these, our new premises, ought to inaugurate a fresh era in the existence of the Folkestone Natural History Society, and infuse new life into our veteran association. "Those should work who never worked before, and those who worked before should work the more." Yes, work; that is what our Society asks of its members. We want more papers read, more specimens exhibited. When any of you meet with a rare plant, flower, shell, or insect, you should possess yourself of it, and exhibit it at our next meeting.

Or you may be fortunate enough to secure some specimen worthy of a place in our museum. I cordially agree with the words of the President of the Museum Curators, Mr. Blanford, in his annual report that the most important object of a provincial museum should be to illustrate the natural history, antiquities, and productions of the place and its immediate neighbourhood.

I was much struck the other day, when reading Professor Flower's admirable address at the British Association, with his account of the earliest collections in connection with natural science, and also with his excellent suggestions for the arrangement of the specimens in museums. He affirms that it was with the revival of learning in the middle ages that the collecting instinct came into existence, and that for some time the earliest collections were formed and maintained at the expense of private individuals.

In England the two earliest collectors of miscellaneous objects were the two John Tradescants, father and son, the latter of whom published in 1656 a little work called "Musæum Tradescantianum." The wonderful variety and incongruous grouping of the various objects in this collection make a most amusing catalogue. The account of this earliest collection is of interest to all lovers of natural science, inasmuch as it shews the marvellous advance scientific research has made in the two last centuries.

Professor Flower points out that the objects of a museum should be two-fold; one being to increase the knowledge of some given

subject, by having numerous specimens conveniently arranged for the scientific naturalist, which should be kept in separate rooms, and supplemented by books of reference on the particular subjects which the specimens illustrate. The second object should be the instruction and amusement of the numerous class, who, without having leisure or ability to make a profound study of natural history, yet take an interest in it, and wish to possess some knowledge of the world around them, and the principal actions of nature

These two ends it was difficult to combine, but it is essential that each specimen should be plainly exhibited and properly labelled; indeed, a well arranged educational museum has been defined as "a collection of instructive labels, illustrated by well-selected specimens." Each fragment should be duly described, and its label must set forth, not only its scientific place and value, but also its relation to the specimens which precede and follow it.

It has been humourously said that "just as in America a pig is put in at one end of a machine, and emerges shortly after in the form of ready packed hams and bacon," so a student may enter, say the mineralogical museum, as ignorant of the properties of stone as are the specimens which meet his gaze, and may leave it with a full knowledge of all that is knowable about mineralogy.

Professor Flower does not include lectures in the arrangement of his model institute, but there is no reason why oral explanations should be excluded. As the guiding rule should be to extract from any such institution the greatest possible utility, and as the intelligence is generally more easily reached by the ear than by the eye, it would seem that a simultaneous appeal to both faculties is the ideal method.

These are the lines upon which our Folkestone Natural History Society has endeavoured to work, and I trust that the lectures with which we have tried to supplement the mute teaching of the specimens in our museum have been a source of pleasure and profit to many.

Mineralogy is, of course, a science to which the labelled specimen readily lends itself as a teacher, but with many other sciences, such as astronomy or physics, this is not the case. Chemistry, again, must be learned almost wholly by oral teaching, illustrated by experiment. Natural history, also, though it affords more readily than any other science specimens for ocular demonstration, can be brought home to the mind of the uninitiated far better by a few words of explanation than by a superficial glance at the natural history cases in our museums. Take, for instance, the study of that marvellous law called "Mimicry in Nature," one of the many interesting facts brought to light by Charles Darwin in connection with his theory of the "Survival of the Fittest." No specimen

could explain that law so well as a few simple words of the great naturalist himself, and which I will quote: "Nature * * * * cares nothing for appearances, except in so far as they are useful to any being. She can act on every internal organ—on every shade of constitutional difference—on the whole machinery of life. Man selects only for his own good—Nature only for that of the being which she tends. * * * * Under nature, the slightest differences of structure or constitution may well turn the nicely-balanced scale in the struggle for life, and so be preserved."

The more closely an animal resembles its surroundings in form and colour so much the more easily can it elude its pursuer, and also escape detection when approaching its own prey. Take for example those moths whose wings are coloured and veined like the fallen leaves on which they lie motionless, or the hunting spiders which mimic flower buds, or the large caterpillars which resemble poisonous snakes. Or the sand-coloured insects of the desert which according to Grant Allen "have become sand-coloured because the least sandy were perpetually picked out for destruction by their ever watchful foes, while the most sandy escaped and multiplied. In the desert, a black, white, or red insect would be immediately detected and devoured by its natural enemies the birds and lizards. But any yellowish insects would be less likely to attract attention at first sight, and would be overlooked as long as there were any more conspicuous individuals. So that in a short time the desert would be depopulated of all but the yellowest insects, which would survive and become the parents of future generations."

In conformity with this law which is in reality a "ceaseless struggle for food and for life," we find that most animals are protectively coloured, except those which are so constituted as to need no such protection. This law of mimicry has been investigated by many of nature's lovers since first its existence was demonstrated by Darwin. Within the last few months most interesting observations in connection with it have been published by Professor Drummond in his fascinating work on "Tropical Africa." I cannot do better than give you one or two of his most striking illustrations in the brief space of time that is allotted me this evening.

Professor Drummond's opinion is that mimicry serves not only as a natural method of protection, but also as warning. For instance, many of the most brilliantly coloured tropical butterflies are inedible owing to the presence in their bodies of acrid juices. Their gorgeous hues are thus hung out as danger signals to their natural enemies, the birds, monkeys, and lizards, which having once feasted upon similar insects have no wish to repeat the experiment. "The same rule," he adds, "applies to all bees,

dragonflies, and all gaily coloured insects, they are either bad eating or bad stingers." On the other hand, the gorgeous tints of many snakes which have been assigned by some naturalists to an instinct of warning, are, according to Professor Drummond, mainly for protection.

Take, for example, the puff adder, a snake from three to five feet long, and disproportionately wide, being sometimes as thick as the lower part of the thigh, which looks when under a glass case, a most brilliant object, but when seen against the vivid colouring of a tropical forest it is scarcely distinguishable from the fallen leaves. He continues, "I was once just throwing myself down under a tree to rest, when, stooping to clear the spot, I noticed a peculiar pattern amongst the leaves. I started back in horror to find a puff adder of the largest size, its thick back only visible, and its fangs within a few inches of my face as I stooped. Had it not been for the exceptional caution which in African travel becomes a habit, I should certainly have sat down upon it, and to sit on a puff adder is to sit down for the last time. Tne peculiarity of this reptile is that it strikes backward, and the moment any part is touched, the head doubles back with inconceivable swiftness, and the poison fangs close on their victim." Thus the colouration of this reptile appears to serve rather as protection for itself than as warning to its victim.

Or again, the zebra, whose black and white stripes would seem to make it such a conspicuous object, is almost invisible amid the dense thickness of a tropical forest, the black and white blending together to form an inconspicuous grey. So inconspicuous, says Prof. Drummond, that he sometimes found himself surrounded by a vast herd of zebras, of whose presence he was totally unaware till it was betrayed by some movement on their part owing to his approach. The spotted leopard, too, conveys the same idea of indistinctness—and along the rivers it is most difficult to ascertain, without close inspection, whether the objects lying along their banks are fallen trees or the mud-coloured hides of crocodiles and alligators.

But the most striking instances of mimicry, both in form and colour, are displayed in various insects of the Phasmidæ and Mantidæ order. These grass-stalk insects live among the tall grasses of the forest, the brown-tinged or spotted appearance of which they closely imitate; their texture and colour are like fine dried hay, but the colour varies according to the season, changing in autumn from a bright red to a deep claret or tawny gold. Prof. Drummond's introduction to one of these insects of the Phasmidæ order can best be told in his own graphic words. He says, "I had stopped one day among some tall dried grass to mark a reading of the aneroid, when one of the men shouted 'Cherombo!' meaning

an inedible beast of some kind. I turned to see where the animal was. The native pointed at myself. I could see nothing, but he approached, and pointing to a wisp of hay which had fallen upon my coat, repeated 'Cherombo.' Believing that it must be some insect among the hay, I took it in my fingers, looked over it, and told him pointedly there was no cherombo there. He smiled, and pointing again to the hay, exclaimed 'Moio"—'it's alive.' The hay itself was the cherombo! I do not exaggerate when I say that wisp of hay was no more like an insect than my aneroid barometer. Take two inches of dried yellow grass-stalk, such as one might take to run through the stem of a pipe; then take six other pieces as long and a quarter as thick; bend each in the middle at any angle you like, stick them in three opposite pairs, and again at any angle you like upon the first grass-stalk, and you have my Cherombo." The members of this family have a marvellous power of shamming death, and having once assumed any position, they never vary one of the angles by so much as half a degree.

Then again there are insects like a walking twig, covered apparently with bark and spotted all over with mould, others which are modelled after the form of mosses, lichen, and fungi; or the still more elaborate leaf insects of the Mantis tribe, some of which resemble shrivelled leaves, and others are coloured a vivid green on their wing cases which are marked like a leaf with veins and mid rib, and have expansions along the thorax, and all the limbs to imitate smaller leaves.

Time warns me that I must only allude in passing to other instances of this world wide and marvellous law of nature, such as the tawny colour of those creatures which inhabit the desert, the vertical stripes of the tiger which mimic the reeds of his native jungle, the brilliant greens of tropical birds and insects, the dusky colour of night haunting creatures, the gorgeous tints of the fishes around the coral reefs, or the sand-like colour of those which live at the bottom of the sea.

In these and the previous examples I have quoted, the grand idea in Nature seems to be economy, "economy of nerve and muscle, of instinct and energy, secured by passivity rather than activity." There is no need for a creature protectively shaped and coloured, to seek safety by flight—it has simply to be still, so that here again we see the beneficence of the universal law of natural selection. We are fortunately no longer afraid of acknowledging this law, and it has been, and should be one of the main objects of this and kindred societies, to encourage liberality of ideas, and faith in the truthful teachings of nature, and to sweep aside the bigotted notion that there is anything incompatible in the truths of religion and the truths of science.

I cannot conclude more appropriately than with Professor Flowers' eloquent words, " For myself I see the strongest grounds for the belief, difficult as it sometimes is, in face of the strange apparent defects in structure, and the far stranger savagery of habit brought to light by the study of the ways of living creatures, that natural selection, or the Survival of the Fittest has among other agencies played a most important part in the production of the present condition of the organic world, and that it is a universally acting and beneficent force continually tending towards the perfection of the individual, of the race, and of the whole living world."

The subject of mimicry produced a short discussion, after which the usual vote of thanks was passed.

November 12th, 1889.

The usual monthly meeting took place at the museum when Mr. Blanford gave an interesting account of the Fauna of India and its distribution. He commenced with a short description of India itself, the mountain districts, plateaus and plains ; the rainfall and the distribution of palm trees. After this he briefly described the various mammals of the country, and the regions occupied by each.

The President was in the chair. The lecturer was warmly thanked for his description.

December 10th, 1889.

A Conversazione was held in the Lecture Hall. Mr. Blanford exhibited a beautiful series of photographs of Himalayan scenery. On the table also where photographs of the Suez Canal, lately presented to the museum ; a specimen of the Chacma, and of some fossil fish from East Wear Bay.

Mr. Walton exhibited botanical and marine objects, Mr. Austen a collection of birds' eggs, and several members of the Microscopical Society were present with the instruments and specimens.

Folkestone Natural History Society.

Established 1868 for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the Summer one or two field excursions are taken.

The subscriptions are of two classes, one Five Shillings per annum, the other Two Shillings and Sixpence. Anyone wishing to join should communicate with the Secretary, at Sea View Villa, Folkestone.

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SEVENTH SERIES.

PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

FOR THE YEAR 1890.

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FOLKESTONE

NATURAL HISTORY SOCIETY,

PROCEEDINGS

TWENTY-SECOND SESSION, 1890.

February 11th, 1890.

ANNUAL MEETING.

The Annual Meeting took place in the Museum Lecture Hall, the President in the chair. Only twenty-one members were present.

The Secretary read the Balance Sheet for 1889, which showed a sum in hand of £15 1s. 4d. After which he read the following report:—

"The number of members at present is ninety. During the past year there have been six evening meetings, one of which, that in December, took the form of a conversazione, and was well attended. At the October meeting there was an interesting exhibition of wild autumn fruits, but the weather was so tempestuous that few of the members ventured out. One field day was held in June—a ramble for orchids on Castle Hill. Not half a dozen members came. The afternoon, however proved very enjoyable, and a fair number of orchids were found, including many speci-

mens of the Bee and the rare Spider. A second field day was arranged at Sandling Park in August, but only three or four names were sent in, so that it was given up. It is somewhat disheartening to the efforts made by the committee, in answer to repeated requests for field days, that such a slight response is made to the invitations sent out. There is still considerable difficulty in obtaining papers to read at the monthly meetings, and we should be heartily glad of any offers that may be made to supply them during the present year. As the chief object for which our Society exists is to spread both the love and the knowledge of Natural History, we do not ask for learned papers, or for original investigations (though such would be warmly welcomed), but rather for accounts of one's own observations of animals and plants, or for one's own thoughts in relation to the theories which are constantly being put forward, and the discoveries which are being made. Interesting discussions would necessarily take place, if we could by any means persuade some members thus to initiate them."

The President then read the following:

ANNUAL ADDRESS.

In reviewing the events of the last few years, two apparently antagonistic facts present themselves to the mind. On the one hand we are amazed at the ever increasing number of scientific inventions and appliances; on the other, we are forcibly reminded of the necessarily slow progress made in endeavouring to fathom the scientific laws themselves. I say necessarily slow, because although the application of scientific principles is continually being adapted to various novel and practical uses, yet research into the theory and cause of any one scientific law often occupies the lifetime of one, aye, even of two or more generations, before its true nature can be grasped.

Take for example, one of the most potent forces in nature, that of electricity. If we ask what is electricity? who can tell us? We know its effects, and to a certain extent we can control them, although the fact of our very limited knowledge, even on this point, has been only too painfully illustrated of late by the numerous accidents which have occurred in America, from imperfect insulation of the wires. Or again—what is the relation between electricity and magnetism? Or what is the real nature of the force we call magnetism? We have most of us seen how simple a thing it is to magnetise an iron bar, so that it has a north and a south pole; and we know that if we break that bar into splinters they

will each still point north and south. But who can account for the marvellous law of nature which causes these phenomena?

In the words of Dr. Hopkinson, in his recent interesting address before the Society of Electrical Engineers, "The more we know of magnetism the more remarkable does it appear. We know that iron, cobalt, and nickel are exceptionally magnetic metals, but no explanation has yet been offered as to why they possess a property which is, comparatively found nowhere else in Nature." Another remarkable feature in these metals is the non-continuity of this magnetic property. For instance, a galvanometer needle connected with an iron ring (the temperature of which latter may be heated to 770 deg. cent.) attains a deflection eleven thousand times as great as if the ring were of copper or glass. But if the temperature rises yet another 15 deg., the value of the deflection suddenly drops to one, that is to say, the iron becomes practically non-magnetic.

Or if we take a still more mysterious force, namely gravitation, who can fathom its cause? No human being can explain the nature of that force which keeps our own planet at the fixed distance of ninety-three million miles from the sun, and which holds together the whole solar system containing vastly greater orbs, and at immeasurably greater distances.

One of the most remarkable effects of gravitation is seen, when approaching the Antarctic regions, in the fall of the barometer, which acts precisely as though the ship were sailing up hill. And, to a certain extent this is really the case, the vast mountain mass of the Antarctic continent drawing the ocean to itself by the force of gravitation, so that it resembles an inclined plane, sloping upwards to the mass of ice.

To natural laws, such as these, and to many other branches of science, hundreds, I may say thousands, of our ablest men are devoting their time and abilities, and year by year appliances are being perfected whereby observations can be made, which in course of time may, and probably will, throw light upon these abstruse points.

At no time has the art of illustrating every science by photograph or diagram been so elaborate as during the past year. Wherever it is possible, the tendency of our workers is to show the result of their observations by illustration as much as by word.

In no science is this more apparent than in astronomy. A superb photograph of the moon has been presented to the Royal Astronomical Society by the Director of the Lick Observatory, where it was taken by means of the great Lick telescope. The photograph is more than two feet in diameter, and the lunar details are very sharply defined. During the solar eclipse of

January 1st, 1889, several fine photographs were taken near San Francisco, by Professor Toll, of the Corona, which extended from 10 to 12 degrees. On this occasion, reports were despatched from the Observatory in the west to New York (a distance of 2,000 miles) in cypher, the cypher was translated, and the translation printed in less than half an hour from the time when the observations were made. The value of this marvellous rapidity will be at once apparent to you. An astronomer who had purposely remained in New York, thus received the despatch from the Western Station before the eclipse became total in New York, and was enabled to verify the observations of the West, or to note any difference he himself perceived in the appearance of the eclipse during totality at New York.

In the more recent solar eclipse of the 22nd of last December, it was hoped that photographs might have been taken, which would shew whether the corona changed during the two-and-a-half hours which elapsed between the total phase at the western and eastern stations. But owing to the presence of clouds over the eastern, viz., the African stations, these hopes were unfortunately frustrated, as no photographs could be obtained. It is, however, believed, that some excellent photographs of another moot point, namely, the extension of the corona and its photometric brightness were obtained in the Salut Isles by the late Father Perry, who may, indeed, be said to have sacrificed his valuable life to his devotion to science.

The application of the photometer to the measurement of the light which reaches our earth from any given heavenly body, is one of the most ingenious inventions of modern times. You are all doubtless aware that the illuminating power of a gas flame or an electric light is estimated by that of a sperm candle, weighing six to the pound, one such candle being the standard unit. To test this power, a photometer is used, the principal of which is simply the equal illumination of the surfaces of two opposite sides of a piece of paper, the candle being put on the one side, and the light to be tested on the other. The weaker light is placed proportionately nearer the paper than the stronger one, the relative distances thus forming an index to the difference of their illuminating power.

Mr. Dibden has applied this principle to stellar photometry, and has invented an apparatus by means of which he can, with the help of an argand burner, produce an artificial star to correspond with any given star in the heavens. In those cases where the approximate distance of a star is known, you will readily perceive that the intensity of its light can be fairly well estimated, by a calculation based on the relative power of the light from the real star, as com-

pared with that from the artificial star. Mr. Dibden has adjusted his instrument so finely, that he can diminish the light of his artificial star to the two hundred thousandth of a sperm candle! I admit that the idea of comparing the light from a star to that of a sperm candle does not sound poetic, but it is at any rate a more exact style of measurement than the vague phrase of a "star of the 1st, 2nd, or 3rd magnitude."

Father Perry, to whom I have previously alluded, had for some years made most interesting observations on sun spots, which have been decreasing in number for the last three or four years. The minimum time is however drawing to a close, and will probably be succeeded by a maximum period of disturbance. Father King, also of Stoneyhurst, has succeeded in taking on an average 258 drawings a year of sun spots, and in many respects they are considered more reliable than photographs, The area of the sun spots sometimes changed as much as one hundred million square miles in a day. Father King suggests that the sun spots may be caused by meteoric streams.

Mr. Isaac Roberts has, as usual, done good work in his admirable photographs of nebulæ. His photograph of the nebulæ in Andromeda shows that it is a bright central mass, surrounded by a stream of nebulous matter, spiral in form. The 81 Messier nebulæ shows a spiral formation, and many bright starry points on the spiral streams. The 51 Messier nebulæ also shows a spiral structure, and lines of stars seem to follow the line of the spiral streams. These photographs are considered so wonderful, that they have been alluded to as a "new cosmical revelation."

Mr. Stanley Williams has made some interesting observations on the planet Jupiter, and has systematically noted the changes in those spots and markings which were sufficiently distinct for the purpose. The red spot, which was so conspicuous in 1887, had become much paler, but the red tinge is still visible; its period of rotation is nine hours, 55 minutes, 40 seconds.

On the 20th September last there was a closer conjunction of Mars and Saturn than at any period during the last six thousand years. That is to say the two planets were almost in the same longitude, their centres being not more than 55 seconds apart, so that to the naked eye they appeared as but one orb.

It is no uncommon event for Mars and Saturn to be in line, but the interest on this occasion was in the smallness of the interval which apparently separated them. And on the 26th of the same month, another rare occurrence, known to astrologers as 'Trigon,' took place, in other words Venus passed within little more than the moon's diameter of Mars and Saturn. A 'Trigon' can only occur once in about 200 years, the last time being in 1603, when

it was formed by a conjunction of Mars, Jupiter, and Saturn. It is unfortunate that observations of any of the planets, although of great scientific interest, are of no avail in elucidating many points on which our curiosity is excited. As, for instance, the much debated question whether they are inhabited, and if so, by what sort of beings! Whether there is any water, any vegetation, or indeed any climate, We know that Mars has an atmosphere of watery vapour, that it has patches of cloud, and that at either pole there are, we believe, ice capped masses just as on our earth. But as Mars is twice as far from the sun as the earth, its average temperature would be about 90 obelow zero, so that if animal or vegetable life exists, both must be formed on a vastly different model from our own. My own feeling is that it would be strange indeed were all the worlds, except our own planet, devoid of life, but at the same time it is, I fear, an idle hope that we shall ever so far bridge over the vast distances of the interstellar spaces, as to fathom their mysteries.

A valuable report has just been issued on "Atmospheric Circulation," based on observations made during the voyage of H.M S. "Challenger." It is, however, impossible for me to enter now into so vast a subject, suffice it to say, that the equability of temperature on sea compared to that on land has been, among other points, clearly demonstrated. In latitude 30, in either the north or south Atlantic or Pacific, the daily fluctuations of the temperature of the sea itself range only from 0.7 deg. to 1 deg., and the temperature of the air ranges only 2.1 deg. to 4 deg., whereas on land the daily range is, as you know, often as great as 10 deg. or even 15 deg. The reason being, that on land the sun's rays are wholly absorbed by a thin layer of the surface of the earth, so that the temperature rapidly rises. On the sea, however, the solar rays penetrate to the depth of at least 500 feet, so that although a much greater depth is appreciably warmed, the temperature is relatively but slightly raised. The report also deals with Barometric changes, the humidity of the air, velocity of the wind, and many other points of great interest and meteorological value.

In September last an important discovery, as regards our maritime interest, was made of a new rock in the Atlantic, on the southern cost of Newfoundland, immediately in the track of vessels making for the St. Lawrence. Although covered by 33 feet of water, it would, if unknown, and unmarked, form a great source of danger to navigation in heavy seas That it has only recently been observed in this well-known track, points almost conclusively to volcanic action, which moreover was, some years ago, demonstrated on the same coast by tidal waves of almost unprecedented and fearful velocity. This is the more remarkable as north

America is, with these two exceptions, a region of almost extinct volcanic action.

Another discovery of perhaps greater interest, though of less importance, has been the revelation of a new lake dwelling, by the drainage of the large turf moor of La Lagozza, in Upper Italy. The building, which was discovered beneath nearly a metre and a-half of peat and mud, is rectangular, and between the still upright posts, lie beams of half burnt planks, the latter having been obtained by splitting the trees without the aid of a saw. Polished stone hatchets, arrow heads, and flint knives were found; also kidney-shaped thread weights and spindle rings of burnt clay, whereas in the Swiss lake dwellings spindle rings of stone only have been met with. Both large and small earthen vessels were discovered, the former, which are rough, are made of clay mixed with pounded pebbles, quartz, and mica. The latter contain only a sprinkling of pebbles in the clay. Traces of animals are altogether absent, and the inhabitants seem to have lived exclusively on vegetable diet. Grains of barley and two sorts of wheat were found, also cherries, walnuts, acorns without their shells, and small apples. No beast of burden seems to have been used by this primitive people, and there is no evidence which points to cattle rearing, or even hunting or fishing.

To turn to a discovery of a more practical nature, that of a continuous vein of uranium in Cornwall seems to have been the event of the year. Although cheaper than gold or silver, it fetches the immense price of £2,400 per ton, or upwards of one guinea per pound. It is of a steel-white colour, and has hitherto been extracted but sparingly from other ores, principally in Bohemia, Saxony, and Hungary. In this new vein, however, at the Union Mines in Cornwall, the assays have yielded from twelve to the almost unprecedented amount of 30 per cent. Of course a larger per centage even than this has occasionally been met with in Bohemia, but then only in minute quantities, whereas this vein appears so far to be continuous. The oxides of uranium are used in porcelain painting, and also in colouring glass, while in photography they are used as a substitute for the more costly chloride of gold. Uranium also forms alloys with platinum and copper, both of which have the appearance of gold itself, so much so that they have been used as a cheap substitute for gold in electro-plating. Moreover uranium, from its high electrical resistance, is an invaluable material for many electrical purposes.

This recent discovery of a comparatively unknown metal shows us how impossible it is to foretell what new metallurgical curiosities yet remain to be found and utilised for industrial or commercial purposes. Gold and silver have so long represented to all nations

the standard of value that we dismiss with little thought others equally rare, and sometimes more beautiful, as for example osmium, osmiridium, palladium, and platinum. The latter is, however, now much used in the most costly and elaborate jeweller's work, but from its extreme rarity and hardness it is even more costly than gold itself. In the event of platinum ever superseding gold coinage, its hardness would of course be a great point in its favor.

A new metal, which has not yet been named, has been discovered by Dr. Kruss. By igniting fresh oxide of either nickel or cobalt with potassium hydrate, he got a solution from which a white oxide was obtained. From this oxide (by means of a blow-pipe) was obtained a brown, malleable metallic powder, soluable in hydrochloric acid. This oxide resembles zinc and aluminium oxides, although it distinctly differs from them or any other known metal; it is therefore supposed to be a new element.

Mr. Matthew Williams has shewn, by an interesting experiment, that by heating certain kinds of coal in an iron or brick retort, it is possible to obtain real petroleum and also a porous coke, which by pressure becomes anthracite. This he assumes was the way in which petroleum was formed in the coal beds, above and below which are porous strata, through which the petroleum percolates and ultimately rises to the surface, where it is sooner or later found by some lucky individual, who, in the words of the famous Gilead P. Beck, "strikes ile."

The following extract from a report by Mr. Findlay, Manager of the L.N.W. Railway, will show you to what perfection one branch of practical engineering has been brought. He writes: "The engines of this one Company run one and three-quarters of a mile every second, and, in effect, put a girdle round the earth every four hours. Yet such is the perfection of mechanism attained in the present day that engines are able to run a distance equal to twice round the world for every single case which occurs of a hot axle, the loss of a split pin, or anything to throw the engine out of gear!" Contrast this most interesting statement with an extract from the "Quarterly" of 1825, when George Stephenson was using every effort to get the Bill passed for making the first railway line in England. The reviewer wrote: "What can be more palpably absurd and ridiculous than the prospect held out of locomotives travelling twice as fast as stage coaches. We trust that Parliament will, on all railways it may sanction, limit the speed to eight or nine miles an hour, which is as great as can be ventured on with safety." I need not remind you that the Bill was thrown out, although it passed, after great opposition, the following year, but so great was the national prejudice against the use of steam power, that the surveyors of the line

were often attacked and injured by the mob and their instruments broken.

The hydraulic railway, or "Chemin de Fer Glissant," which was inaugurated at the Paris Exhibition, and in which Sir Edward Watkin takes so great an interest, is an ideal mode of travelling as regards swiftness of motion; the sensation resembles that of travelling in a sledge over ice in perfect condition, and is, in fact, similar in method, the carriages being mounted on sledge plates, between which and the rails a thin film of water is interposed. The propulsion of the train is effected by horizontal columns of water from hydrants placed at intervals along the lines. M. Barre claims for his invention that the speed of 140 miles an hour can be obtained! Sir F. Bramwell considers the experiment highly interesting, but his opinion, in which the majority of our leading engineers coincide, is that it will hardly answer for long distances or for heavy commercial traffic. When we remember, however, that sixty years ago George Stephenson was the only engineer in this country who believed in the ultimate triumph of the steam locomotive, we shall beware of asserting that any new invention or suggested improvement is an impossibility.

One of the most important factors in the Naval warfare of the future, is to be, we are assured, the pneumatic dynamite gun, which was recently tested in the novel American torpedo craft. the Vesuvius. Captain Zalinski's invention displayed in its trial performance a capacity of throwing projecti'es beyond even the claims of the contract, which stipulated that 15 shots should be fired in 30 minutes, whereas the actual result was, that 15 shells, each eight feet in length, and 15 inches in diameter, and holding respectfully 200lbs. of explosives, were discharged in 16 minutes 11 seconds. The pneumatic pressure used in throwing these shells was 750lbs., but the air reservoirs are capable of containing a volume of 2,000 lbs. The range is obtained by varying the pressure of air behind the projectile. Although many of these guns are ordered by the American government, the Vesuvius is, at present, the only vessel where they are mounted. She is a large torpedo boat of 246 feet in length, and 26 feet in breadth, and carries as her chief armament three of these Zalinski guns, fixed parellel with one another, at an angle of 16 degrees above the horizon. The guns are capable of throwing shells containing 100, 200, or 600lbs. of explosives, and can thus fire a broadside of over 1,500 lbs. of dynamite per minute. With weapons of such deadly power, a few shells would suffice to wreck any vessel or fort which came within their range, and as the Vesuvius has a freeboard of only 5 feet, she does not herself afford a prominent target to the enemy.

In our own country, considerable advance has been made in the

manufacture of smokeless powder, which, if carried to perfection, will, in Lord Armstrong's words, "work a revolution in modern armament, and render the use of quick-firing guns not only an advantage but a necessity." The new powder is impervious to damp and absolutely smokeless, thus offering no impediment in aiming or discharging the large guns, at their maximum rate of 10 rounds per minute! Velocities have been also obtained with this powder of 2,300, and 2,500 feet per second.

Turning to the vast subject of electricity, the year 1889 can boast of no specially important application of its power. The electric lighting of the Metropolis is steadily progressing, but until some method is devised of perfecting the insulation of the wires, the scheme seems likely to meet with great, and perhaps just opposition. So great, however, has been the development of electricity in the last few years, that upwards of five million persons now gain a livelihood by its means.

The electric lighting of the British Museum which has only recently been accomplished, is in every sense of the word, a brilliant success. The antiquities, Roman Mosaics, and Porcelains are superbly illuminated, but the effect is specially fine in the sculpture galleries, where the light and shade are so perfect that every detail is brought out in quite an unprecedented manner, and enables studies to be made with better effect by night than by day. Hence it is hoped that the treasurers of our great National Museum may more be enjoyed by many who have been hitherto precluded from studying them. The electric current is generated by four Siemens Dynamos, and four currents are led round the building, two to the upper, and two to the lower floors.

An ingenious process for making filaments for incandescent lamps has been devised by Messrs. Swinburne, from ordinary cabbage leaves. They are first soaked in vinegar to neutralize their alkali, then in a solution of mercury bromide,and electrolysed while therein by an electric shellac rod. A heavy current is then passed through the leaf to carbonize its vegetable fibre, after which it is cut into filaments and passed through a draw plate. Lastly a mixture of hydrogen and ammonia gases are passed over the filaments to give them a due resisting force, when they can be bent into horse-shoe shape, and are then ready for use.

What may be called an abuse of this wondrous force, i.e., electricity, may be seen on the southern shores of France, where wires connected with powerful batteries, are placed along those parts of the coast where the migratory birds usually alight when returning from their winter sojourn in Africa. The wearied birds perch on the wires, and are instantly struck dead. I shall hardly be believed when I say that it is to please the gentle sex, for whose adornment

(?) the Paris modistes have adopted this plan, as a ready means of obtaining the much coveted birds for various decorative purposes!

Another scheme to which electricity lent its name for the purpose of fraud on a gigantic scale, was that of the New York Electric Sugar Refining Company," of which the manager refused to give any further information than that the raw sugar was poured in at the top of the machine and somehow electrified, when presto! it ran out at the bottom in cubes fully formed! Dupes of this scheme were so readily found, that the 100 dollar shares ran up quickly to 300 dollars. When, however, about 250,000 dollars had been realized, the presence of the said manager was suddenly and urgently required "Out West," whence, I need hardly say, he has not returned! When the deserted machine in New York was examined, it was found that the sugar put in at the top was principally in the form of refined cubes, similar in every respect to those which emerged from the bottom of the machine!

In connection with the telephone, the wires of which are being rapidly extended throughout the country, the latest news is of a peculiar complaint it appears to have developed, called characteristically "Telephonic Tinitus." This malady attacks those who are much engaged in the use of the instrument, and consists principally in irritation of the drum of the ear, accompanied by various other unpleasant effects, such as intolerance of sound, giddiness, and neuralgic pains. As, however, only those of a very highly strung temperament appear to succumb to this complaint (which happily disappears after a short period of rest and relaxation) it does not seem likely to assume alarming proportions. There are indeed few callings or trades which do not engender some specific form of disease, such for example as the housemaid's knee, the pulmonary affection of the coal-miner, clergyman's sore throat, the lawn tennis arm, not to mention the corns and bunions entailed by the persistent use of the fashionable pointed shoe!

Another dangerous contrivance which science has put at the disposal of the fair sex is the use of glass flux, now so much in vogue for giving a glittering appearance to flowers, ornaments, and ball dresses. There are few substances more injurious to health when scattered through the air of a ball-room; every grain is a sharp particle of glass which is liable to inflame the eyes, and, if inhaled, sets up serious irritation of the bronchial passages. Ground glass is one of the most deadly slow poisons, and was at one time much used as a murderous agent. We may therefore hope that this domestic poison whose dangers so far outweigh its beauties, may be abandoned by the fair sex, who are, as we know, always ready to discard any foolish fashion at the behest of reason!

A simple, but at the same time scientific method of improving

one of our home industries has lately been adopted, namely the preservation of butter for a lengthened period by means of salicylic acid. A very small portion of the acid is dissolved in two parts of lactic acid and ninety-eight parts of water; this mixtute is used in the proportion of one grain of salicylic acid to one hundred kegs of butter, and will keep the latter fresh for an almost indefinite period.

In my last annual address I mentioned the sponge industry at Gratz. Since then an interesting report has been issued of the sponge farms of Cuba, in which it appears that the demand of these sponges is likely to be an increasing one. They do not, of course, equal the fine Turkey sponges in texture, yet they are largely employed in damping tobacco, and also in cleaning the machinery in use on the sugar estates. In the Isles of the Bahamas, poetically termed the "land of the pink pearl," the sponge farms alone give occupation to upwards of five thousand people. In Florida, too, successful experiments of sponge growing have been made, but the chief drawback to this industry is, that under the most favourable circumstances, the farmer must wait five or even seven years before his first crop is available. Therefore sponge farming, like tree planting, may be considered somewhat "an heroic culture!"

Photography, which is both a science and an art, held what may be called its Jubilee exhibition last March at the Crystal Palace. Could Col. Daguerre and Fox Talbot themselves see the vast strides this art has made since their day, they would indeed feel proud to have inaugurated an art which has attained such superb results, both artistically and scientifically. The perfection of the photographic instruments, and the artistic merit of the pictures exhibited, called alike for the highest praise. The little floating magnesium lamps have improved, and form a valuable and ready means of taking views independently of sunshine. In connection with this elaborate photographic display, a special feature was the admirable finish of the oxyhydrogen lanterns for exhibiting many of the photographs. The high pressure of 3,000lbs. to the square inch, by which the gases are now forced into steel tubes to supply the light, is reduced by a simble appliance in the jet, which impinges on the hard lime wick, giving a small but most intense light, and one eminently suited for lantern lenses. The screen too on which the views were presented is prepared in a novel manner, by covering the canvas with an enamel of white zinc paint, which prevents the woven texture showing through the smooth surface, and thus much enhances the clearness and beauty of the views.

There is no scientific point which is still undergoing more searching investigation than that of the influence of bacteria, and various

micro organisms upon life, from its humblest up to its highest forms. M. Giard, a French naturalist, has recently made some highly interesting experiments on the phosphorescence of various crustacea. This appearance has long been known to be an infectious disease, but it has now been definitely traced by M. Giard to the presence of bacteria in the muscles of the crustacean. He inoculated several healthy specimens from one which was phosphorescent, and so quickly was the infection conveyed that his laboratory was quite illuminated by these diseased specimens. The disease was, moreover, continued in an unattenuated form through five or six generations, each crustacean dying within three or four days. The phosphorescence lingered some hours after death.

The oral aperture of flies has been found to be swarming with bacteria. which may account for the sometimes poisonous effects of their bite. Indeed micro-organisms abound everywhere and in the most unsuspected places. A Russian scientist lately discovered that even hailstones are teeming with them, and that their number averages no less than twenty-one thousand to every cubic centimetre.

M. Pasteur continues with unabated zeal his valuable experiments for the prevention and cure of disease, but no fresh discovery of special importance was recorded by him last year.

In various places investigations are going forward as the cause of that terrible disease, leprosy, of which we have heard so much lately. Although a specific form of bacillus is said to be found in leprous subjects, yet its method of propagation is still unknown. A fund is, however, being raised in this country to found scholarships for two students. one of whom will make Europe and the other India and the Colonies the field of his research, and it is hoped that this may lead to a better understanding, and consequently better treatment of this dread malady.

The fashionable complaint of influenza may also probably be attributed to the chemical action set up in the system by some specific form of bacillus. Indeed two doctors in Vienna, Professor Weichselbaum and Dr. Jolles, claim severally to have found the genuine influenza bacillus, which they describe as closely resembling the pneumonia coccus discovered by Dr. Friedlander. In this country one gentleman claims to have found it by sending up into the air a kite, spread with a layer of treacle, which became covered with a prickly hedgehog-like coating of microscopic organisms, which he believes to be the veritable influenza bacilli. Dr. Symes Thompson, in his recent interesting lectures on the subject, says that a similar epidemic is described by Homer, and that in this country its first recorded appearance was in 1173, and several outbreaks seem to have occurred during each century since the 14th

century. Mary Queen of Scots suffered from it, and in a letter of that period still extant it is fully described and referred to as "The new acquaintance" There is also existing an account by a Dr. Short of a visitation of influenza to Madrid in 1510, when "two thousand were let blood off and all died," and "so great was the mortality, that the poor fought for coffins for their dead relations." It is indeed a cause for congratulation that owing to a more enlightened system of treatment, no such appalling results have occurred during the present epidemic.

One of the most important subjects which science has yet to solve is that of free ventilation for our large cities. In Dr. Ballard's report, which was presented last session to Parliament, he enforces the necessity of sufficiently wide streets, that these should be broken at frequent intervals by cross streets or squares, and that every house should have free breathing space, back as well as front. He also emphasises the point that all places where food is prepared, sold, or stored, should be freely exposed both to light and air, and lastly that cleanliness in all such places should be enforced by local authorities to the utmost of their power. Dr. Ballard also insists that the practice of keeping food in a cellar or underground pantry in a private dwelling-house cannot be too strongly deprecated.

Referring to another important point of sanitation, Mr. William Webster's invention for disposing of sewage by electricity is one worthy of attention The sewage flows through a long channel, in which are a number of iron plates, connected with a dynamo and traversed by the electric current; it is thus brought into immediate contact with the electric force, and a chemical action is set up, by which the suspended matters are precipitated. So effectual is this action in purifying the sewage that, parodoxical as it may seem, a powerful disinfectant is produced from it consisting of hypochlorous acid, the strongest oxydising agent known. The working cost of this scheme is said to be only thirteen shillings per million gallons. or six-tenths of one farthing for a thousand gallons. The annual cost for the whole of London is therefore reckoned at about £36,000 per annum.

Another method of treating sewage is that of Mr. Hugo Wollheim. This process consists of mingling milk of lime and herring brine with the sewage, which is then run into tanks to settle. The lime averages 47 grains, and the herring brine three grains per gallon of sewage. The suspended matters are precipitated in about half an hour, and a clear effluent is produced, which Dr. Klein pronounces absolutely free from living organisms, and the residium of sludge is perfectly inoffensive. The cost of materials ranges from ½d. to ¾d per thousand gallons, or about £2 or £3 per million

gallons, this scheme being from three to five times as costly as Mr. W. Webster's.

Time warns me that I must not trespass much longer on your attention, but before concluding, I should like briefly to mention one of the greatest engineering works of modern times, namely the Forth Bridge, which has been in progress for the last seven years, and which is now virtually complete. The sea, which is here over a mile in width, has been bridged over—the actual length of the bridge being 8,296 feet, or nearly a mile and five eighths. It comprises 15 girders of 168 feet each in length, which are simply the approaches to the main viaduct, which crosses the intervening space of nearly a mile by four spans, namely two of 1710 feet each and two of 680 feet each. The largest span of any bridge in this country, viz., the Britannia, is little more than a quarter the length of the vast spans of the new Forth Bridge. The towers on which the shore ends of the spans rest are themselves a stupendous engineering work, meaning 360 feet high—than which, only the Eiffel Tower, Cologne Cathedral, and the great Pyramid are higher structured works. The tensible strength of this bridge is estimated at from 30 to 37 tons to the square inch, whilst the utmost strain likely to be put upon it, either by wind or weight, is barely one-fifth of that amount. The bridge has been most satisfactorily tested by massing upon the two main spans fifty loaded coal waggons and three of the heaviest engines and tenders, the total weight being over 1,800 tons, more than double the bridge will ever be called upon in future to bear. The deflections were in exact accordance with the calculations of the joint engineers, Sir John Fowler and Mr. Baker.

Some idea of the vastness of this triumph of engineeing skill may be gathered from the following statistics. The foundations and piers contain about 130,000 cubic of granite, concrete, and rubble masonry, while the bridge itself consists of 53,000 tons of steel. Eight million rivets hold the fabric together—the surface to be painted is equal to twenty acres. Between three and four thousand men have been employed on this gigantic task for the last seven years, and the total cost will be two and a-half million sterling, which sum is to be defrayed by four railway companies, who are uniting in this enterprise for their mutual convenience.

The successful acchievement of this grand work inspires us with confidence for the future. The scheme of a bridge across the channel is now occupying many minds, and in the light of what has just been done, it seems presumptuous to affirm that such a thing is impossible. Time alone can settle this vexed question—it may be that ere many years are passed, the scheme of to-day will have become an accomplished fact, and we shall then perhaps,

look back on the achievement of the Forth Bridge as insignificant, when compared with the grander works of which it will have been but the precedent.

The officers for 1890 were then re-elected, the name of Mr. C. Rosling, B.A., being added to the committee.

The Secretary then stated that with very great regret, owing to weak health, he must ask to be relieved from his duties. He felt that it would be for the good of the Society that some one younger, and able to put forth more energy should occupy the post. He begged to suggest his son, Mr. Arnold H. Ullyett.

Great regret was expressed by the President and several Members, and Mr. Ullyett was asked to re-consider the matter. However, he so evidently wished for relief from his duties, that it was proposed by the Rev. W. Hall, and seconded by Mr. Knight :—

That Mr. A. H. Ullyett be asked to take the office for a time, until perhaps Mr. Henry Ullyett may feel justified in resuming it.

This was carried unanimously.

March 11th, 1890.

Mr. A. H. Ullyett gave a Lecture on "Minute Organisms," illustrated by Lantern Slides. The subject was made exceedingly interesting by the clear descriptions and the representations on the screen. The lantern was lent and manipulated by the Rev. T. Day. The attendance was large, and a vote of thanks was proposed and carried with acclamations. The Rev. T. Day also received a vote of thanks

Mr. Walton then exhibited and briefly described a few of the local zoophytes.

May 21st, 1890.

The last meeting of the session was held in the Lecture Hall of the Museum. Mr. C. Rosling, B.A., read an interesting paper on "Ants," which was illustrated by Lantern Slides shown by the Assistant Secretary who kindly lent his Lantern and the necessary apparatus. The attendance was small, only thirty being present.

A vote of thanks was given to the lecturer.

Mr. Walton exhibited fresh specimens of *Orchis purpurea*, and some other rare plants.

OCTOBER 21ST, 1890.

The winter session commenced with the following paper by the Secretary, entitled

HOW GREAT BRITAIN BECAME AN ISLAND.

In addition to the general difficulty one experiences in knowing *how* to begin a paper our subject presents another still more serious, namely, knowing *where* to begin. We have to describe how Great Britain became an island. How far back in its geographical history and development shall we travel to find a starting point? For the land in which we live has literally and actually seen so many "ups and downs in the world" that we scarcely know how to choose. We might commence, and it would be a very good starting point, with its condition in what has been styled the Great Ice Age, when Great Britain was a group of innumerable islands of all forms, heights, and sizes, all swathed in snow and ice. Or we could commence with the Coal Age, when it was mostly a collection of low-lying swampy areas with a sub-tropical climate; or farther back even to the time when, we are told, "the earth was waste and empty, and darkness lay on the face of the deep." Shall we explore the dark recesses of Time still further, and trace in imagination what has happened since the earth was part of a huge nebulous mass, out of which they say our Solar System in all its beauty has been evolved? Or with a mind still unsatisfied, shall we endeavour with Dr. Croll to picture out how that nebulous mass itself was produced. The world is so old.

I remember reading in one of our leading monthly reviews a few years ago an exceedingly interesting history of the noted Victoria Cave near Settle, in Yorkshire, in which the last method but one was actually followed, and the talented writer described all the steps and changes since the nebulous condition of the earth to the state of the cave when it was explored by our modern geologists. But on the present occasion it will I think be preferable to begin somewhat nearer to our own times, at some epoch where we find firmer ground upon which to build our descriptions; and we shall probably get a sufficiently clear idea, at least so far as a clear idea can be got, by tracing the changes which have occurred during what geologists call the Tertiary Age, the latest of the three great Life periods into which the physical history of the earth has been divided,—that during which (at least in our country) all the deposits above the White Chalk have been laid down. This White Chalk in England marks the close of the great Secondary or Mesozoic Period, and gives us

a fairly definite epoch. And to us in this part of England it is a familiar formation, devoid of the dimness and strangeress connected with more distant periods such as are illustrated by the rocks in Scotland or the extreme west of England. Let us commence then with the Chalk age.

It is I suppose hardly necessary to point out to you that chalk is a marine deposit, full of sponges, fish remains, and shells of molluscs, from which its history is easily extracted. What and where was Great Britain in those days? Since the chalk is a deep sea formation, if we trace out the chalk deposits in England we can tell at least what parts were covered with sea in those far-off times. Note then how the chalk occurs in our island. We have our own local range of the North Downs reaching from our cliffs as far to the west as Salisbury Plain. Nearly parallel runs the range of the South Downs from Beachy Head to the same place. A short spur extends south into Dorsetshire, and disconnected outliers are found in Devonshire. A great escarpment runs from Salisbury Plain, north-east to the Wash, re appears in Lincolnshire, and again in Yorkshire, terminatng in Flamboro' Head. Then undoubtedly all those districts were under the sea in Chalk times. But we cannot limit the submergence to those parts; if what are now *hills* formed the bed of the sea so did the lower lying districts between these ranges occupy a similar position, and further, they must have been covered with the same deposit of chalk, which has since been removed by various natural agencies.

But now we also find chalk in Ireland in the County of Antrim, and again on the West of Scotland in the island of Mull, and in the district of Morvern in Argyleshire. The sea must thus have extended at least to those parts, how much farther it is not easy to say.

Let us try to realize the physical condition in which our islands then lay. There was certainly no island corresponding to what we call Great Britain. Whatever of land there may have been before then, geologists are pretty certain of the following facts:—the whole of what is now the eastern and central parts of England gradually sank, the slope being as at present towards the east, and the eastern waters (where the North Sea is now) slowly encroached upon it. First the Lower Greensand was laid down, then the Gault, and as the depression went on, the Upper Greensand, not evenly everywhere, in some places not at all, for the depression was not necessarily uniform, and the high grounds were of course the last to be submerged. Still the sinking continued until this old sea washed the feet of the Welsh Mountains, reached into Devonshire, and stretched north-west across to Ireland, and along the west of Scotland. Then the highest parts of Wales became

islands, Ireland probably an archipelago; "the British Islands," says Jukes Brown, "had never been so deeply submerged since the commencement of Mesozoic times." Towards the end of the movement, "it would seem that little of England or Wales could have remained above the level of the sea." And in this sea which must necessarily have been a deep one, 400 or 500 fathoms—the White Chalk was deposited to the thickness of 1,300 feet in the east, but much less westward, especially in Antrim because of the lateness of the submergence there. At this epoch it is certain that the greater part of western and southern Europe was covered by an ocean which may have been continuous from the southern part of North America, across the Atlantic, and through Europe into Asia."

If I have been able at all to impress on your minds a fairly clear picture of the great depression of the British Isles at the time when the White Chalk was being deposited, it will not be very difficult to follow out the successive changes which occurred afterwards. They are all due, it must be borne in mind, simply to alternate upheavals and subsidences, representing the mighty secular pulsations and throbbings of our globe, which seem never to have ceased, and which can be detected even at the present time.

Starting then from the times of this great Cretaceous Sea, when only the very highest parts of our islands stood above water, a gradual upheaval of the western portion of the European continent commenced, until the greater part of the British Islands emerged as one continuous area, connected with the continent by way of Cornwall, Devon, and Brittany. Probably the rising was more rapid to the west, for Belgium remained covered long after the emergence of our own country. Certainly the first parts to become land would be the mountainous and hilly districts of Scotland, Ireland, and Wales; and along the shoreline no doubt fresh deposits were laid down, but if so they have been completely removed by denudation; in England nothing comes between the Chalk and the Eocene beds, to be referred to presently. The elevation must have amounted to at least 600 feet above the present level, and it was probably three or four times as much. We must remember that this new land-surface was the former bed of the chalk ocean, so that there would be "broad plains of chalk uniting Wales to the Pennine Chain, and Ireland to both England and Scotland," as well as covering all middle, eastern, and southern England. And over these of course all the atmospheric forces would have free play as at present; the rains fell and formed springs, these produced rivers and streams which cut and carved the surface into valleys, and, assisted by frost carried on the work of denudation.

There was also almost certainly land stretching from Ireland and Scotland by way of the Faroe Islands and Iceland to Greenland, thus cutting off the cold waters of the northern Seas from those of the present Atlantic. In this way we can account for the warmer climate of that period as shown by the character of the vegetation. Indeed along this pathway (which is now traceable as a submarine ridge) our best authorities tell us the Eocene flora travelled from the Arctic Regions which then had a subtropical climate.

While water was doing its work there was great volcanic activity in the north of Ireland and along the west of Scotland, and this continued far on through the next two periods; the remains of the volcanoes are to be seen in Mull, Eig, Skye, and other parts of the Hebrides. Their present ruinous condition (for they are mere stumps) points to the enormous time that has elapsed; and the lavas themselves are now scored out into numerous valleys, watercourses and riverbeds, showing a plenteous rainfall.

The earliest of the Eocene deposits, as those of the period succeeding the chalk are called, are those known as the Thanet Sands, laid down when the sea had again slightly encroached on the south east. It then gradually advanced, and occasionally through upheaval receded, until as the map shows, in the time of the deposit of the London Clay it covered the whole of south-east England from the Wash to Dorsetshire, and stretched over the north-east of France. The deposits are sometimes marine, but oftener estuarine, or freshwater—a proof of a series of minor elevations and depressions. The Isle of Sheppey yields us remains of palms and gigantic pines; also the skull of a bird (Odontopteryx)[1] having regular toothlike projections along the edge of the mandible. Bournemouth, in Hants, has yielded a large supply of leaves and other plant remains buried during this period. They are so abundant and well preserved that we can form a good idea of the nature of the locality and of the changes it passed through.

We notice in Eocene deposits the appearance of the placental Mammalia, all those before having been marsupials. Some of the forms partake of the characters of both divisions. These all made their way across by means of the land connection on the south with the plains of France, One of the most striking facts in connection with this period is the sudden, apparently abnormal increase in the numbers of the mammalia. Some of these are shown on the next slide; the Quadrumana are represented by a kind of Lemur, a family now found in Madagascar; the Palœotherium and Anaplotherium among the hoofed animals, and the Xiphodon, a lighter deer-like form of the same group. The landscape on the next slide gives an ideal restoration of the general

conditions. Turtles and crocodiles have left their remains behind in the London Clay, and beside the Odontopteryx already mentioned there were herons, kingfishers, gulls, vultures, and other large birds. All the species, however, are now extinct, and there are no signs of man nor of any of the mammalia most nearly related to him in structure. And Britain was not yet an island.

During the next period, the *Oligocene*, upheaval still went on, more land was exposed, and a connection was made across the Strait of Dover. All western Europe participated in this movement, so that there was free communication with Africa in more than one place. Across these pathways came multitudes of new genera and species from the south; Cornwall, Devon, and the south-east of Ireland were mountainous districts with no separation between them and France beyond the valley of a large river. The greater part of the North Sea became dry, driving the waters southward, but there was no connection with the Atlantic. During this upheaval many lakes must have been left behind, and one interesting set of lacustrine deposits has been preserved in Devonshire near Bovey Tracey. It appears to have been a lake at least 300 feet deep and covering about five and twenty square miles, fed by the rivers Teign and Bovey, then quite independent of each other. Dartmoor stood there as now, but looking down on this lake, whose waters reflected the forms of such trees as the Sequoia, evergreen oaks, figs, cinnamon, laurels, vines, and gum-trees, while large clusters of water lilies floated on the surface. Everything betokened a warm climate.

Still the elevatory movement continued, and through all the *Miocene* period, Great Britain and Ireland appear to have remained dry land, as no deposits of this age, or any signs of them are to be found here; we were still part of a large continent, European on the east, and stretching to Greenland and America on the west. The North Sea formed a vast Miocene plain, watered by rivers from the Scandinavian mountains, from Holland and Belgium, and on the opposite side by those from Great Britain. There is at the present time off the south-west coast of Norway a submarine valley 200 feet below the sea-bed; possibly this is the valley of a large Miocene river. The Miocene Age was a long one, as is shown by the great changes which took place in the animals and plants. Large areas of chalk and Eocene deposits were removed by the rains, rivers and frosts of the time; the great oolitic escarpment stretching from the Cotswold Hills to the N.E. was formed; the Thames commenced to carve out its present valley, though probably only as a tributary of the Rhine; and the dome of the Weald was lifted up, and most of the chalk cleared off it.

Large numbers of new genera and species made their appearance, some of them no doubt across the North Sea Plain, but no mammalian remains have been found here, though on some parts of the continent they are abundant. The kind of mammalian life then prevalent will be seen from the next slide ; the whole of the species are extinct. And we are without any remains of Man. According to Professor Boyd Dawkins we have no right to expect them. It will be seen how improbable, nay, how impossible it is that Man, the highest and most specialized of all created forms, should have had a place in the Miocene world. The evolution of the animal kingdom recorded in the rocks had at this time advanced as far as, but no farther than, the Quadrumana. Although this reasoning has been controverted by Jukes Brown, I find that Mr. Evans, in his recent address to the Geological section of the British Association this year, expresses this same opinion of the Tertiary period generally, and founds it on the same reasoning. It is only right however to mention that the existence of Miocene Man is believed in by some good authorities.

So far we have no signs of the existence of our country as an island. But now a depression set in towards the east, and continued into and through *Pliocene* times. The land connection with Greenland was considerably narrowed but not broken through, unless perhaps in the latter part of the period. It appears almost certain that the extreme south-west of England sank, and that Cornwall became a small archipelago, for early Pliocene deposits have been found at St. Erth. It is noticed that no northern forms have been found in these beds—a fact which seems to show there was no communication between the Arctic and the Atlantic. The south part of the North Sea district was elevated as shown on the map, while all the other part became so depressed that free communication was opened with the Arctic Ocean, thus enabling species of northern shell-fish to find their way south. There was still connection on the south with Europe, the English Channel forming the valley of a large river flowing to the west and receiving as tributaries the streams from France on the left bank and from southern England on the right. The Chalk Range was continuous across from Dover, and perhaps also from the Isle of Wight.

The best known Pliocene deposits of England are the *Crags* of Norfolk and Suffolk, belonging to the later portions of the period. The contents of the Norwich Crag tell us there must have been a large estuary formed by a river coming from the west or northwest. From the nature of the pebbles brought down it appears to have been the Trent, which at that time flowed through the oolitic and chalk ridges of Lincolnshire, and was one of a group of rivers which helped to form the gap in the chalk now known as The Wash.

Our knowledge of the later portions of the Pliocene Period is more distinct and definite; further changes took place, and the character of the physical geography is gathered from the nature of an interesting deposit on the coast of Norfolk called the "Forest Bed." As we examine its contents we feel that we are approaching modern times. The southern area of the North Sea had become an extensive plain, covered with forests of spruce and Scotch firs, oaks, beeches and elms, and through it all wandered a large river. Scattered over this plain were numerous shallow lakes, in and on the borders of which grew white and yellow water lilies, pond-weeds such as you see in the ponds on the Warren, Buckbean, and other familiar forms. These meres probably resembled the present Norfolk "Broads," which may in fact be the remnant of Pliocene days.

Driven by the increasing cold there wandered into Britain from northern and central Asia numerous forms of mammals, most of which, but not all, are now extinct; *e.g.* Mastodon, Rhinoceros, Deer, Hipparion (an ancestor of the horse), Elephant, Hippopotamus, Bear, &c. In the Forest Bed we find remains of Beavers, Voles, Squirrels, Moles, Shrews, Mice, Wolves, Foxes, etc., showing how rapidly we are approaching modern times—modern, geologically I mean, though according to ordinary reckoning many thousands, if not hundreds of thousands of years have passed since then, and many strange changes have yet to be described.

An examination of the pebbles composing the gravelly portion of the deposit by Mr. C. Reed shows it to have been laid down by a river, and that these pebbles could not have been brought there from the north or the west, but only from the south and east; the river therefore could have been no other than the Rhine, the estuary of which in those days was on the coast of our Norfolk and Suffolk as shown on the map.

No satisfactory traces of Man have as yet been proved to occur in Pliocene deposits.

We now come to the latest geological period, that known as the *Pleistocene*, which shades off imperceptibly into the Prehistoric Age by which it is linked on to the Present. It was characterized by several upheavals and subsidences, but more especially by the fact that for part of it at least, all the British tract, in common with the northern portions of Europe and Asia, was reduced to conditions in almost all respects like those prevalent in Greenland at the present time; this period is known as the Great Ice Age, or the Glacial Period. To this most interesting of all geological epochs only brief reference can now be made, but we hope to describe it more fully on a future occasion. The marks and signs left behind are unmistakeable and can be read of all men,—

groovings and scratches on the rocks of our mountain districts, heaps of moraine rubbish in the valleys such as we see now at the termination of the Swiss glaciers, and enormous deposits of "drift clay" collected by the ice in its travels and deposited as the glacier melted.

All through Miocene and Pliocene times the temperature had been gradually lowering, as we see by the increasing prevalence of Arctic forms of life and the lessening numbers of such as are now found in warm seas. As the cold developed itself more and more southwards and at last produced the ice masses, so the animals and plants were gradually driven in the same direction until the reindeer grazed on the plains in the south of France. Whenever the cold moderated, as it did more than once, animal life swung northwards, and the mammoth and hippopotamus were preyed upon by hyenas as far north as Yorkshire. From river gravels and from cave deposits all over our land we have extracted a rich harvest of animal remains, sometimes of curiously mixed families owing to the variability of climatic conditions.

Sir C. Lyell, in his "Antiquity of Man," describes the following successive geographical states of the British and adjoining areas:— First, a continental period when the upheaving movement at the close of Pliocene times continued until the land stood at a much higher level than it does at present. "Britain formed part of the mainland, and the bottom of the old Pliocene sea became the feeding grounds of the animals which have left their remains in the Forest Bed, and all over and around the Dogger Bank. Ireland must also have been united to Britain to allow of their finding their way so far to the west." At the same time, and perhaps partly in consequence of this elevation the temperature was lowered, and the country was invaded by numerous species of mammals from the north and west of Asia, where of course the climate was still more extreme. At length it became too cold even for these; snow and ice covered all the higher portions, while huge glaciers radiated from Scotland, Cumberland, and Snowdon, the marks of which I just now mentioned. Probably we owe the Scandinavian portion of our flora to this time.

Then set in a period of submergence; the shore-line retreated, and the glaciers deposited the boulder clay as they melted, and portions of them drifted off as icebergs as far at least as the valley of the Thames. Arctic mammals came in, driven gradually southward, and the Scandinavian plants "which occupied the lower grounds during the previous continental period may have obtained exclusive possession of the only lands not covered with perpetual snow." (Ant. Man. p. 331).

Then gradually the climate grew milder, and a fresh movement of elevation occurred; the bed of the glacial sea became dry land, covered with forests of oak, yew, Scotch fir, and ash, while new species of the Pleistocene mammalia found ample food for themselves. Glaciers remained on the higher parts of Scotland and Wales, but they slowly disappeared; the Scandinavian plants, insects, birds, and quadrupeds retreated to the higher grounds, where some of their descendants remain to this day; and our share of the Germanic flora made its way across the North Sea Plain. It is this later stage of the Pleistocene Period which is depicted on the map. The coast line, as you see, stretched much farther north and west than at present, 200 or 300 miles west of Ireland, and onwards to the inner angle of the Bay of Biscay. All the sea within this line at the present time is less than 100 fathoms in depth, but immediately outside it sinks rapidly to several thousand feet; it is then in reality the true western coast-line of Europe, and the British Isles at present rise from the enclosed surface as from a submarine plateau. If an elevation of 600 feet were to take place now, this state of things on the map would be restored. Let me direct your attention to one or two interesting features in the map:—the present North Sea was a broad undulating plain rich in vegetation, and was the feeding ground of herds of animals whose bones and teeth lie scattered over it at the present time in immense numbers. The Dogger Bank was "a part of western Europe, its southern and western sides washed by the waters of a large river" coming from the south and flowing onwards to the deeper parts of the North Sea. This river was the Rhine, which then received the Thames and all the rivers of eastern Britain as feeders. The English Channel had no existence, but was a wide valley similarly drained by a river flowing to the west. The Bristol Channel was also a valley through which the Severn flowed to join a much larger stream draining the lake and plain of the present Irish Sea. One interesting proof of this is found in the fact of the small island of Caldy off the coast of Pembrokeshire having yielded an abundance of remains of large mammals which must have required extensive feeding grounds. "It may be concluded," says Professor Boyd Dawkins, "that when they perished in the fissures Caldy was not an island, but a precipitous hill overlooking the broad valley now occupied by the Bristol Channel, but then affording abundant pasture. We must therefore picture to ourselves a fertile plain occupying the whole of the Bristol Channel, and supporting herds of reindeer, horses, and bisons, many elephants and rhinoceroses, and now and then being traversed by a stray hippopotamus, which

would afford abundant prey to the lions, bears, and hyænas inhabiting all the accessible caves, as well as to their great enemy and destroyer—Man."

For we have certainly arrived at last at the advent of our own species. Along with the mammals from the south wandered the highest of them all, very low in the scale of humanity as yet, it is true; only a nomad hunter, but still a Man, already asserting his dominion over the fowls of the air and the beasts of the field, and having latent within him, savage as he was, all the infinite possibilities of our nature. He came then originally into Britain *by land*, long before it was an island, certainly towards the close of the Glacial Period, possibly before. No fossil remains of these early men have yet been discovered in Britain, although they have on the continent. But undoubted tokens of their presence have been found in no stinted numbers in the form of roughly chipped flint tools and weapons in the gravels deposited by the rivers. These early unpolished specimens such as that shown on the slide are termed *Palæolithic*, and have been found in the gravels in the valley of the Thames high above its present level, *i.e.* to say, they were deposited there long before the river had cut down to the present depth; also at Fisherton near Salisbury, Axminster, and numerous other localities. Man lived here then in company with the mammoth, the woolly rhinoceros, the lion, hyæna, and hippopotamus. Let me quote to you another of the inimitable word-pictures scattered throughout Professor B. Dawkins' "Early Man in Britain":—

"The primeval hunter, who followed the chase in the lower valley of the Thames, armed with his rude implements of flint, must have found abundance of food, and have had great difficulty in guarding himself against the wild animals. Innumerable horses, large herds of stags, uri, and bison, were to be seen in the open country, while the Irish Elk and the roe were comparatively rare. Three kinds of rhinoceros and two kinds of elephant lived in the forests. The hippopotamus haunted the banks of the Thames, as well as the beaver, the water-rat, and the otter. There were wolves also, and foxes, brown bears and grisly bears, wild cats, and lions of enormous size. Wild boars lived in the thickets; and as the night came on the hyænas assembled in packs to hunt down the young, the wounded, and the infirm."

The union of Ireland to England, and of England to the continent was probably continuous during the latter part of the Pleistocene Period, lasting long enough for two invasions of Palæolithic men, and some think even for the Neolithic. But no doubt subsidence was gradually going on, and it was certainly completed to severance before all the animals and plants now found

in Europe had made their way so far to the west. Ireland was separated first, and consequently has a more limited fauna than England, whose connection with the continent lasted much longer. This is shown by the fact, pointed out by Mr. Wallace in his "Island Life," that Germany has 90 species of mammals, while Britain has only 40, and Ireland 22. Also Belgium has 22 species of amphibia and reptiles, while Britain has but 13, and Ireland only 4. So that Ireland became separated from us before more than 22 kinds of mammals and 4 kinds of amphibia and reptiles had secured a permanent footing there.

And so the subsidence continued; the North Sea crept further south, and the Atlantic worked its way up the Channel, until the two united at the Strait of Dover, and Great Britain became an island. So it has continued ever since. Many minor and local changes have occurred, and are still in progress. We have no grounds for looking upon the present state of things as final, or to imagine that the results of these changes may not be of the same magnitude as those I have attempted to describe.

The Lecture was illustrated by Lantern Slides, and by a series of maps illustrating the Physical Geography of Great Britain during the Tertiary Period. The Lecture Hall was completely filled, and great interest was shown in the subject.

NOVEMBER 11TH, 1890.

A combined meeting of the Natural History and the Microscopical Societies was held, and took the form of a Conversazione. A large number of objects were shown; the attendance was very good. The Secretary was absent through illness.

The following Societies have arranged to exchange their publications for those of our own:—

The Scientific Association, Meriden, Conn., U.S.
The Academy of Sciences, New York.
The Academy of Sciences, Philadelphia.
The Elliott Society of Science and Arts, Charleston.
The Rochester Academy of Science, Rochester, N.Y.
The Imperial German Academy, Halle-on-the-Saale.
The Tunbridge Wells Nat. Hist. Society.
The Huddersfield Naturalists' Society.
The East Kent Nat. Hist. History.
The Brighton and Sussex Nat. Hist. Society.
The Eastbourne Nat. Hist. Society.
The Harrogate Nat. and Scientific Society.
The Geological Society, Glasgow.

The Philosophical Society, Glasgow.
The Manchester Microscopical Society.
The Oldham Microscopical Society.

Their publications can be seen on application to the Secretary.

Folkestone Natural History Society.

Established 1868 for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the summer one or two field excursions are taken.

The subscriptions are of two classes, one Five Shillings per annum, the other Two Shillings and Sixpence. Anyone wishing to join should communicate with the Secretary, at Sea View Villa, Folkestone.

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EIGHTH SERIES.

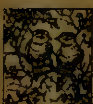
PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

For the Year, 1891.



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FOLKESTONE

NATURAL HISTORY SOCIETY.

PROCEEDINGS

TWENTY-THIRD SESSION, 1891.

JANUARY, 13th, 1891.

The Annual Meeting was held in the Lecture Hall of the Museum. There were fourteen present. The President took the chair and called upon the Secretary to read the Balance Sheet, which is here given.

BALANCE SHEET FOR 1891.

RECEIPTS.	£	s.	d.	EXPENSES.	£	s.	d.
Balance from last year	5	1	4	Printing proceedings	4	17	6
Subscriptions ...	13	17	6	Printing & Postage	3	0	3
Moiety of Mrs. Rumsey's gift ..	10	0	0	Lantern Slides ...	0	9	0
				Cleaning & Attendant	1	0	0
				Commission ...	0	13	10½
				Sundries	0	4	1½
				Balance in hand ...	18	14	1
	£28	18	10		£28	18	10

SECRETARY'S REPORT.

The number of members on the roll is 95, of whom 76 paid their subscriptions for the year.

The number of meetings during 1890 was five, the smallest number we have ever recorded during the existence of the Society. The cause of this is solely the difficulty in obtaining papers from the members to be read at the meetings. The annual meeting took place in February, when the President gave his usual address on the progress of discovery during the preceding year. In March Mr. A. H. Ullyett gave an interesting lecture on "Minute Organisms," illustrated by means of lantern slides. The lantern for the occasion was lent and manipulated by the Rev. T. G. Day.

In April a special business meeting was called to clear up some misunderstanding which had arisen concerning the resignation of the Secretary at the previous annual meeting, most of the members apparently having understood that it was both partial and temporary. Explanations were given and it was left in the hands of the Committee to settle. Ultimately the Secretary withdrew his resignation and Mr. A. H. Ullyett was appointed as Assistant Secretary.

In May, Mr. C. Rosling, B.A., late of the Grammar School, gave a paper on "Ants," at which lantern slides were used.

During the summer no field days were held as it had been found during the preceding summers that members were not sufficiently interested in them to attend.

The winter session commenced in October with a Lantern Lecture by the secretary on "How Great Britain became an Island,"

In November a very successful combined meeting of our Society and the Microscopical Society was held, from which the Secretary was absent through illness. It is desired here to record the thanks of the Society for the assistance then rendered by members of the "Microscopical," and to express a hope that such meetings will be often repeated.

The attendance at the meetings has been good, but has consisted largely of non-members, whom however we are always glad to welcome.

The balance sheet shows that we had at the close of the year a sum of £18 14s. 1d. in hand, £10 of which is half of the sum presented by Mrs. Rumsey to the Society before that lady left Folkestone.

In conclusion, I can only express a strong hope and wish that the interest of members may be aroused to a further extent in matters connected with the Society, and that our meetings during the present year may be somewhat more successful both in the number of papers read and in attendance.

It would greatly contribute to the interest of the meetings if members and their friends would kindly bring to them for exhibition and explanation any objects of interest which they may meet with from time to time, especially microscopical preparations.

Proposed by Dr. Eastes and seconded by Mrs. Walton

That the Report and Balance Sheet be received and adopted. Carried unanimously.

The President, Dr. FitzGerald, then gave his annual address on :

THE PROGRESS OF SCIENCE IN 1890.

—:o:—

"There is nothing new under the Sun," so says the wise man, and I suppose none of us will deny the truth of that assertion; nevertheless the discoveries and inventions with which this century has been fraught, are, at any rate presented to us in the guise of novelties. It is to science that we are indebted for the adaptation of the old and immutable laws of nature to the needs and demands of the world's ever increasing population. The progress of science is so rapid, that the accepted theory of to-day may have to be abandoned to-morrow; indeed, the history of science has been, not inaptly termed "The history of exploded errors and forsaken doctrines!" I was much struck when reading the report of the British Association's meeting at Leeds last autumn, with the comparison drawn by Sir F. Abel, between the scientific summary of the great naturalist, Professor Owen, in his inaugural address at Leeds in 1858, and that which he (Sir F. Abel), was prepared to deliver to his hearers. To give you an illustration, thirty years ago Darwinism was hardly known and the "Survival of the Fittest" was a theory not as yet propounded; the electric telegraph was then in its infancy, and the successful laying of an Atlantic cable was held to be more than doubtful. The Metropolitan Railway had not then been commenced, and electricity as the motive power for trains, steamboats, or tram-cars was unthought of; the electric light was not then devised, nor was the telephone or phonograph invented.

There is no doubt that electricity is the special branch of scientific research which has, during the past thirty years, been of the greatest practical use to mankind. It is a curious coincidence that the first Electric Lighting Bill was passed in 1882 in the year in which the late Sir W. Siemens was president of the British Association, and although much delay has arisen in the practical working of the scheme, it is now in a fair way to be accomplished, the delay having been of actual service in affording

time for the development of many practical details necessary to its ultimate success. Already nine companies are at work supplying from central stations, the electric light to the greater portion of the western and north western districts of the Metropolis, and there are twenty-seven lighting stations now at work in various towns in England, besides many others which are in course of being established, and it is to be hoped our own town will not be long without so desirable an improvement. Our American cousins are, however, far in advance of us in this respect, for whereas in America there are two hundred and thirty five thousand arc lamps, and three million glow lamps in use, we have in England but one hundredth the number of the former, and one tenth the number of the latter. So practical indeed are the inhabitants of the new world, that we learn (not without a romantic feeling of regret) that Siemens' dream of utilising the force of the vast cataract of Niagara, is now on the eve of realisation. We, however, hold the foremost rank in the efficient application of the electric light for our passenger ships and our Navy, and, indeed, for all purposes of coast defence. It has also been adopted for signalling from captive balloons, as a lighthouse illuminant, and for the lighting of the main roads in coal mines, and indeed in no place more than the latter, is the electric light likely to be of practical service, in averting those terrible calamities which so often arise from even the most guarded use of lamps in coal or other explosive mines.

The electric railway which was opened in London last November, and which is the first of its kind in England, seems likely to be most successful. The motive power being electricity, there is an entire absence of the sulphurous atmosphere which prevails in other underground railways from the fumes of coal or coke fires, and the use of separate subways for the up and down trains tends still farther to ensure the purity of the air. The entire line is over three miles in length, and the run is performed in fifteen minutes; the trains consist of three carriages, capable of carrying a hundred passengers, and a locomotive containing two dynamo motors, the permanent generating station being at Stockwell. The current is supplied to the line at an electromotive force of one hundred and fifty volts, and is taken from the line by brushes which feed the dynamos as the locomotive travels on. It is said to be an easy and agreeable method of travelling, the motion being absolutely free from vibration. The carriages and stations are all provided with incandescent lamps, and the passenger stations are accessible from the line by hydraulic lifts. The engineers to the line are Sir John Fowler and Sir Benjamin Baker, the famous engineers of the Forth Bridge.

Electricity has now for some years been frequently adopted as

the motive power for small river boats, many of which are to be seen on the upper reaches of the Thames during the boating season. In Germany and America electricity is much used in mines for haulage work; in this country it was first successfully used both for haulage and pumping in mines, by Mr. Immisch in the Normanton colleries, two or three years ago.

To Sir W. Siemens we are indebted for the introduction of the electric furnace for smelting metals; the reduction which this has effected in the cost of the production of aluminium has enabled that metal to be extensively used as an alloy for other metals, thus not only enhancing their valuable properties, but in many cases imparting to them novel characteristics. The subjects of the hardening and tempering of steel is of vital interest to the gun-maker; his treatment in the manufacture of his guns being, of course, largely influenced by the quality and nature of the steel with which he has to deal. It is barely thirty-five years since the discovery that by the addition of a fixed quantity of carbon to molten iron a cheap and excellent steel could be produced. This Bessemer steel is now made yearly at the rate of ten million five hundred thousand tons, as against a yearly manufacture of fifty thousand tons by the old process. And in the United States the Bessemer rails produced are even double in number to those manufactured in this country. To give you some idea of the magnitude of the steel rade in the present day, I will mention a few statistics relative to the works of Messrs. Krupp, the famous German gun makers. The works at Essen cover one thousand acres, the number of men employed being twenty-five thousand, who live in the Krupp village of eight thousand cottages. The works contain four hundred and thirty-nine steam boilers, four hundred and fifty steam engines, eighty-two steam hammers, eleven large furnaces, and one thousand five hundred and forty-two smelting stoves. The amount of iron ore used daily is one thousand five hundred tons, and the consumption of fuel is four thousand tons of coal or coke per diem.

Before quitting the subject of steel, I will draw your attention from the "infinitely great" to the "infinitely small," namely to the manufacture of steel pens, for the production of which eighteen tons of steel are used daily in this country alone. The invention of steel pens was due, like so many other inventions, to a trivial accident. In 1830 Mr. Gillott, who was then a working jeweller, accidentally split up one of his fine steel tools. Being suddenly in need of a pen, he used the spoiled implement as a ready substitute, and found it answered so admirably that it suggested to him a new departure in the manufacture of pens. It is said that the firm of Gillott alone produces as many pens in a day as all

the geese in England could supply of quills in a year, a matter of no inconsiderable importance in these days of universal education.

In connection with the subject of gun-making is that of explosives for guns. It has been proved that those explosives which furnish the largest proportion of gaseous products, and whose explosion is attended by the smallest amount of heat, exerts the least erosive action on the inner surface of the gun. To combine these desiderata with the property of a smokeless powder has been for some years the aim of many practical chemists, but although many kinds have been invented and tried with partial success, such as the nitro-cellulose powder of Colonel Schultze, and the nitro-glycerine powder of Mr. Nobel, none is entirely satisfactory, the almost insurmountable difficulty being to produce a powder which shall remain free from chemical changes when exposed to extreme variations of temperature. Some months ago an experiment was made in London with the Giffard gun, in which liquified carbonic acid gas is used as the expulsive agent. The liquid is contained in a small steel magazine attached to the under-side of the gun, and is sufficient to discharge three hundred shots. The charge of liquid for each round is contained in a special chamber, and is released by the pulling of the trigger. The bullet is dropped separately into an orifice in the breech block. The pressure of the fluid in the magazine is five hundred pounds to the square inch. There is no heating of the barrel by this new propelling force, nor is there any erosion of the inner surface of the gun, and merely a slight vapour, which instantly fades away, is noticeable when the gun is discharged.

Although considerably behind either France or America in the use of the telephone, we are rapidly increasing our means of telephonic communication with our friends in the United Kingdom, and it is hoped that before many weeks have elapsed the telephonic cable between London and Paris will be completed. The line will be laid *via* Maidstone, Ashford, Folkestone, Dover, and St. Margaret's Bay to Calais. Messrs. Siemens are the electrical engineers to the line, which is the first real submarine telephonic cable in existence. The number of telephones now in use in this country is ninety-nine thousand, and in America they have reached the immense number of over two hundred and twenty thousand. Only thirteen years have elapsed since the telephone was first employed as a practical apparatus, and there are now upwards of one million telephones in working order throughout the world.

A new species of mechanical telephone has lately been invented by Mr. Mellett, of Massachusetts, in which electrical agency is altogether discarded. This instrument, which is called the "Pul-

sion telephone," acts by means of "pulses," which are set up in the transmitting wire by an intensely sympathetic vibratory arrangement at the mouthpiece. The disc, or diaphragm, is of metal, and is connected with a series of small metallic springs placed in a case behind the disc. This arrangement is found to be most effective in producing harmonised vibrations, and it is this vibrating battery (so to speak) of spiral springs which gathers up, intensifies, and transmits the sound to the telephonic wire. This pulsion telephone was tested some months ago on the Midland Railway, for a distance of three miles, first with a taut and then with a slack wire, and in both cases with marked success, conversation, singing, and playing at the one end being perfectly audible at the other. This telephone, which has now been in use for some months in America, is highly thought of by several of our railway companies and by the Post Office, and a company is being formed to establish its working on this side of the Atlantic. It has one great recommendation, that it is a cheap instrument, and the wires can be laid at the small cost of from thirty to forty shillings per mile.

A still more marvellous instrument than the telephone, or even the phonograph, was exhibited last summer at the Post Office Jubilee celebration. I allude to the electrophoscope, by which you not only hear the voice, but see the face of the person addressing you. The effect was thus described by an eye-witness: "On entering a little cabinet you see before you on the wall a funnel-shaped disc, brightly illuminated by four electric incandescent lamps; you put the telephone to your ear, and ring your correspondent up. His face is seen immediately in the centre of the disc. You speak and he replies. His countenance changes its expression, he laughs, looks solemn, grave, or gay by turn. The features of the person at the other end could not have been more distinct had they been looked at from a short distance, through the object lens of a spy glass." From this account the new invention seems likely to not only annihilate time, as in the case of the electric telegraph, but also space, if it can call up over any intervening distance the face of the listener or speaker. But whether this fanciful apparatus will ever be turned to any practical use is, I imagine, somewhat doubtful, especially as the inventors carefully withhold any account of the mechanism of the contrivance. It sounds, indeed, not unlike the description of the developments of science in the year 2,000, as told in the amusing pages of Mr. Bellamy's "Looking Backward."

Another recent invention of the practical utility of which I am somewhat sceptical, is the so-called "galvanic chair," which, we are told, will be largely used for dental and surgical operations.

By means of a battery under the seat of the chair, with which the patient is put in communication by two electrodes which he will hold, he will be so effectually galvanised that he will lose all sense of pain. It is claimed for this invention that it will become an effectual substitute for anæsthetics, in cases where they cannot be safely employed."

To turn from the subject of electricity to a higher branch of science, namely astronomy, perhaps the most interesting event of the year was the annular eclipse which took place on the 17th of last June, and of which I had a good view from Lucerne. The moon being at the time in apogee, her apparent diameter was not large enough to cover the entire face of the sun, but at places where the eclipse was central, a ring of light was visible round the moon's dark disc, hence the term annular eclipse. This amount of light is sufficient to deprive an annular eclipse of that scientific interest with which a total eclipse is invested, nevertheless it presents by no means an uninteresting spectacle, and the gloom of the sky is in some cases so deep as to render visible the planet Venus, bright stars, and sometimes also Mercury; delicate plants too have been known to close their flowers, as during the total eclipse.

Professor Schiaparelli, who has been observing the planet Mercury for upwards of nine years, finds that it revolves round the sun in the same way as our moon revolves round the earth, always presenting to it the same face, hence its axial rotation is performed in the same time as its orbital revolution, that is to say, in eighty-three days. The spectrum of Saturn's rings has been under close observation at the Lick Observatory, and as no lines but those of the solar spectrum can be detected, it is concluded that the rings are not self luminous. An interesting conjunction was expected last autumn between the large red spot in Jupiter, which has been now observed for twelve years, and a dark spot on the southern belt which has been gaining for some time on the red spot. The result of the observations has not yet been published; it was thought that it would take two months for the one spot to pass before and obscure the other.

The phenomenon of variable stars, namely those which periodically lose their brilliancy, and then after a fixed interval resume it, is one which affords immense interest to all astronomers. During the past year Professor Vogel, of Potsdam, has published most valuable reports of his observations; he finds that in the star Algol (as indeed is thought to be the case with all variable stars), the periodic comparative darkness is caused by the revolution of a dark satellite across the disc of its primary. Professor Vogel shows that the respective diameters of Algol, and its

satellite are one million, seventy-four thousand, one hundred miles, and eight hundred and forty thousand, six hundred miles; the speed of the former in its orbit is twenty-seven miles per second, and of the latter, fifty-six miles per second. Roughly speaking, Algol is less than half the mass of the sun. The observations of Mr. Monck, of Greenwich, confirm those of Professor Vogel.

Mr. Isaac Roberts, the celebrated amateur photographer, has, by means of his stellar photographs, done good work in determining the variability of Algol, and similar stars. By his method all atmospheric, actinic, and chemical changes are eliminated; thus the study of the variability of the stars can be pursued under the most favourable conditions.

A novel apparatus has been fixed to the Great Lick Telescope, by means of which it is hoped that still better photographs may be taken of the moon, which will yet farther increase our acquaintance with our satellite. Professor Holden has already taken five photographs of the successive phases of the moon which give an admirable representation of the long lunar day, from sunrise to sunset. These photographs are published in America at popular prices. Some superb photographs of the moon, which show the lunar craters in the most striking manner, have also been taken in Paris, by M. M. Paul and Prosper Henry.

Theophilus, the deepest of the lunar craters, and whose diameter is sixty-four miles, is seen standing up eighteen thousand feet above the chasm. The diameter of these photographs is over one yard, and they are said to surpass even those from the Lick Observatory in clearness of definition.

From Grahamstown last autumn was reported the discovery of a new comet, or at any rate of one whose orbit brought it for the first time within our view. It appeared at 7.45 p.m. on October 27th, on the western horizon, and after performing a rapid journey of at least ninety degrees it disappeared in the south east at 8.32 p.m., having only been visible for about three quarters of an hour. When first seen it was about thirty degrees in length, but it soon attained the length of ninety degrees, and stretched along the southern horizon like a "ribbon of weird grey light." This comet possessed no visible nucleus, and was of extreme tenuity, for the lustre of several bright stars, across which it passed, was not diminished by its transit. The moon at the time was at the full.

A remarkable meteor is said to have passed over Iowa last May, having a comet-like tail. Its passage was accompanied by a rumbling hissing noise, and it burst some eleven miles from Forest City. The fragments which were scattered over the

ground are of porous stone of a grey colour, spotted with brown and black, and analysis shows that they contain silica, iron oxide, aluminium oxide, lime, and magnesia.

Great satisfaction is expressed by French meteorologists by the discovery of the permanent value of the Eiffel Tower for weather observations. They are in fact as satisfactory as those obtained in the Observatory on the Pic du Midi, the altitude being almost the same. The temperature is found to be far more even than on *terra firma*, and while frost was experienced in the streets of Paris, the observers on the summit of the Eiffel Tower were enjoying a warm breeze. The velocity of the wind is found to be about three times as great as on a level with the ground, but whereas the wind is usually most noticeable on the earth's surface from noon to 2.0 p.m., at great elevations it is strongest from sunset to daybreak, and abates toward the noontide.

The French have recently added captive balloons to their naval equipment, and the Mediterranean squadron is now supplied with one which can be raised or lowered at will. Lieut. Terpette found that by ascending to the height of one thousand two hundred feet all the details of the coast from Marseilles to Hyeres, and every vessel within thirty miles could be clearly seen. And what may prove of equal service in these days of submarine warfare, the sea appeared to be transparent to a depth of eighty feet. Thus, in calm weather, all treacherous attacks from torpedo boats might be effectually guarded against. These small balloons, which are made of China silk, are very strong, and resist the action of the wind. They are made at Chalais Mendon.

A new submarine boat has been invented for the Italian Government by Signor Balsamello, and from the preliminary experiments it appears to be highly successful. The unique feature in this new vessel is that its form is spherical (balla nautica, as it is called), and it can be steered in a direct line, either on or below the surface of the water, and it can also be turned with ease. It is fitted with lenses, so that those in the vessel can not only see their way, but can discover any submerged article they may wish to bring to the surface. The exterior of the vessel is provided with grapnels, which can be worked from the interior. On the trial trip a large beam with weights attached was thrown overboard from an adjacent boat. The submarine boat sank after it, and shortly re-appeared with the beam, which had been seized by the grapnels. It is hoped that much sunken and valuable cargo may thus be rescued by this and similar vessels, and it is also thought that submarine photography may be practised by this means.

In our own country the first steam lifeboat was launched last year, and made a most successful trip. She is named after the

President of the Association, the Duke of Northumberland. She is capable of carrying thirty people beside the crew, her speed is about eight knots an hour, and from full speed ahead she can be brought up in thirty-two seconds, and way can be got on her again in four seconds. She is stationed at Harwich, and is likely to afford invaluable aid in cases where an ordinary life-boat would be useless.

A new scheme for a Channel Tunnel has been devised by a talented young French engineer, M. Bunau Varilla, who claims that it can be easily constructed, finished in five years, rendered absolutely safe against danger in times of international warfare, and that it would only cost the trifling sum of sixteen million sterling. This scheme, however, does not appear to offer any advantage over that suggested by Sir E. Watkin.

Recent explorations in the valley of the Seille, near Metz, have brought to light some interesting specimens of pre-historic brickwork, or briquetage, as it is called. Beneath the remains of several Roman villas have been discovered large masses of this briquetage, which were evidently thrown upon the marshy ground as foundations for the Roman buildings. As no trace of Roman or Celtic remains have been discovered among or beneath the brickwork, the Abbe Paulus, who is deeply versed in these subjects, considers that it is evidently the work of the primitive inhabitants of the country, namely of pre-historic man, and that it was made by him, partly for foundations for the lake dwellings and also for salines, for the manufacture of salt. There is good reason to believe that the marshy land was in those days a lake. The bricks are of various colours, red, yellow, green, or black, and of different sizes, varying from ten to thirty centimetres in length, and from three to seven in width. Some are smooth, some rough, as though from the markings of the straw on which they were laid when soft, while others still bear the marks of their maker's fingers, and in some cases they even show the markings of the skin. All such discoveries which tend to throw light on these long past ages, must always afford the keenest interest to the scientific and enquiring mind.

The coal field in our neighbourhood is a subject of vast importance, not only to ourselves, but to the world at large, for with the increasing demands upon our coal supply, not only for fuel and gas, but for purposes of machinery it must sooner or later be exhausted. It is estimated that the annual consumption of coal is, for each inhabitant in England, seven thousand four hundred pounds, in Belgium, four thousand two hundred pounds, in Germany three thousand pounds, and in France one thousand five hundred and sixty pounds, wood and charcoal in that country being largely used in place of coal. It is an interesting fact in connection with the discovery of coal in Kent, that more than a quarter of a century

ago Professor Prestwick explained his reasons for believing that coal existed at no very great depth, in the south east of England, thus linking the coalfields of Somerset with those of Belgium and France, and establishing the geological fact of the subterranean connection of the Mendips with the Ardennes. Whether the coal in Kent is sufficiently valuable in kind or abundant in quantity to pay for the working, has not yet been fully ascertained

The various and great industries in connection with petroleum are remarkable for having been entirely developed during the last thirty years. It was not till 1859 that the first petroleum well was drilled in America, and in that year five thousand barrels were produced; last year the yield was twenty-one million five hundred thousand barrels! In Russia, where crude petroleum is largely used as fuel for locomotives, many million gallons are used in working the railway traffic on the Caspian Sea; in Russia alone, three million tons of petroleum are produced yearly, In America the natural gas furnished by the oil fields is extensively used, and in Pittsburg three hundred and thirty-five miles of pipes have been laid down, through which this natural gas is supplied, and which equals in heating power three million six hundred and fifty tons of coal. The effect of this change from coal gas to natural gas on the purity of the atmosphere is most marked. Water gas, in combination with a certain proportion of a very luminous coal gas, is now extensively used in New York, Philadelphia, and other large towns in America, and is found to be far purer and better, both for illuminating and heating purposes, than the ordinary coal gas.

An interesting discussion has been going on in the French Academy of Science, as to the nature of the diamond, M. Daubree asserting that it is not of vegetable origin, but of inorganic nature, like graphite, which is found in South Africa in the same rocks as the diamond. The presence of the diamond as carbonado (as well as transformed into graphite) in fragments of meteorites, lends great weight to this assertion. A curious chemical achievement has just been accomplished by Mr. Greville Williams, of manufacturing a perfect emerald from the refuse of a gas retort. The cost, however, of producing it is ten times as great as if it were bought at a jewellers. In 1837 M. Gaudin produced real rubies by artificial means, and some ten years ago Mr, Hannay, of Glasgow, succeeded in manufacturing genuine diamonds, but in all these cases the cost has been prohibitive, and the processes, though of great scientific interest, are of no commercial value. It is for this same reason, *i.e.* the cost of production, that Saccharin is commercially valueless, although it is two hundred times as sweet as sugar.

It would really almost seem as though one of the functions of science is to make us unlearn all that we learned in our youth

Among other novelties, we are now told by Mr. Reeves, a botanical revolutionist, that sap in a tree does not rise from the roots, but is derived from the moisture in the atmosphere, which the leaves imbibe and elaborate into sap. The only nutriment, he asserts, that ascends from the roots of the tree, are the gases which it inhales from the interstices of the surrounding earth. Mr. Reeves bases his theory on the law of gravitation, which compels fluid to descend, and allows gases to ascend, but he omits from his calculations the physical laws of osmosis and capillory attraction, by both of which there is little doubt (if we may rely upon the testimony of our most eminent botanists and chemists) that the life of a tree or plant is maintained. The leaves of a plant doubtless absorb water to a certain extent, but if the foliage of a plant be watered and the roots left dry, it will soon whither and die, whereas if the roots be kept well supplied with moisture, the plant will live even though the leaves be unwatered; this fact certainly tends to disprove the truth of the new theory.

Much interest was excited in the minds of many botanists some months ago, by the assertion of Herr Nowach, of Vienna, that he had discovered the "weather plant," which is none other than the well known tropical abrus precatorius. By the special request of H.R.H. the Prince of Wales, Herr Nowach came over to this country and in connection with Professor Oliver and Mr. Weiss made many elaborate experiments at Kew Gardens with this interesting plant. That it is highly sensitive to light, Professor Oliver admits, but he is convinced that its claims to being a weather prophet must be abandoned; for in spite of numerous changes in the weather during its time of probation, not one did the plant fortell; nor was it any more reliable in fortelling the advent of earthquakes, or fire-damp in mines, of which Herr Nowach claimed to come within the range of the plant's prophetic capacity.

A remarkable instance of the effect of electric light on vegetation was shown last spring in Leipzigerplatz, Berlin, where the branches of the lime trees facing the light were clotted with verdure, while on those turned from it the buds were not fully formed. We hear from America of a plant, the coraaria thymifolia whose juice supplies a ready made ink of a reddish brown colour, but which turns black after use; this useful shrub has been aptly termed the "ink-plant." We are also told that in France, an ink has been made, which is guaranteed to fade utterly from the paper in eight days. What a boon this will prove to the ardent lover who need no longer fear to give free vent to his most passionate protestations when addressing his mistress, knowing that, should time somewhat abate the ardour of his feeling, an action for

" Breach of Promise " has no longer any terrors for him, as in the brief space of one week, all his effusions will have vanished, leaving no trace behind ! A simple and ingenious device for obtaining a copy of leaves insects, etc., is now adopted by Her Awer, in the Government Office at Vienna. The object is placed between sheets of blotting paper, pressed and dried ; it is then placed in water and again left to dry ; it is then laid on a smooth lead plate covered with a steel plate, and exposed to presssure. A mould is thus obtained from the impression left on the lead, and the copper plate prepared from this mould can then be used in the press.

The illustration of books, newspapers, etc., by means of " process blocks " has almost entirely superseded the old method of wood engraving. The practical method of producing these blocks for press by photography, was described by the inventor in 1865, and as early as 1869, Mr. Davenport declared that at no remote period this process of photo-galvanography would as inevitably supersede wood engraving, as photography has rendered miniature painting obsolete. So largely is this branch of the photographic art practised, that several large workshops are open for this purpose in the City, day and night ; by means of the electric light, photography is now practicable at any time, and a block can be prepared from the first to the last stage in the incredibly short space of one hour !

Time warns me that I must close, but I cannot conclude this address without some reference to the most sensational event of the year, namely the discovery by Professor Koch of his alleged remedy for tubercolosis. The very unusual method in which Professor Koch has thought fit to announce his discovery to the scientific world, together with the secrecy which still enshrouds the preparation of the lymph, and the fact that the treatment savours slightly of a commercial speculation, are all alike somewhat repugnant to the majority of scientific men, and to professional feeling in this country. All, however, who are interested in the welfare of humanity and the diminution of disease, cannot fail to regard with keenest interest an experiment which may possibly materially lesson the number of victims to the dire malady of phthisis. The discovery is, of course, as yet in its infancy, and must for the present be regarded simply as in the experimental stage, and although immediate benefit may apparently result from the treatment, yet the final issue cannot be known for many months or even years.

As a diagnostic agent the lymph appears to be of great value, its electrive affinity for tuberculous matter being so marked, that an injection of 0.1 centimetre usually produces a severe re-action in a tuberculous patient, whereas a similar dose hardly re-acts at all in a healthy subject.

In the early stages of the disease, Professor Koch has implicit faith in the curative value of his remedy. To use his own words, "Phthsis in the beginning can be cured with certainty by this remedy." But in Phthisical cases where the lung substance is to any considerable extent destroyed, although the general condition of the patient may be improved, the lost tissue of course cannot be replaced. And, as a matter of fact, in some advanced stages of the disease, the injections have been attended with fatal results. If, however, this remedy should happily fulfil the promise claimed for by its discoverer, we may truly be said to be at the beginning ot a new era, such a one as the world has never known, for the same principle which underlies the Koch treatment could, if true, be applied to all diseases, and the bacteriologist and innoculator will reign supreme. Whether this utopian dream will ever be realized is beyond my province to determine—time alone can show. In the meantime, every conceivable test will, doubtless, be impartially applied to the new remedy, and we may confidently hope that, in the end, real benefit to mankind will accrue from the patient and indefatigable labours of Professor Koch, even should the remedy fall short of the brilliant results prophesied for it by his too sanguine disciples.

Dr. T. Eastes added a few remarks, and proposed a vote of thanks which was seconded by Mr. Blandford and carried unanimously.

The President and Vice-Presidents were then re-elected; also the committee with the exception of Mr. Rosling, who has left Folkestone.

The Secretary and Assistant Secretary were then re-elected.

Mr. Walton once more called the attention of the members to the main object of the society, viz., to work out the natural history of the neighbourhood. It would be advisable at each annual meeting to have a list prepared of the discoveries and additions to the Fauna and Flora of the district during the preceding year.

February 10th, 1891.

Thirty-two members were present. Mr. Walton exhibited some lichens, and the curious fruit of *Sagus amicarum*. The Secretary read the following paper forwarded by H. F. Rutt, Esq.,

ON TAILS.

The subject of Tails is a wide one. In order to narrow it somewhat, I shall confine myself, in this paper, to the tails of *vertebrate* animals. But it will be found necessary to include, along with

these, certain distant relations of the Vertebrates: namely, the *Tunicates* or *Ascidians.*

Our first step must be a definition. What do we understand by the tail of a Vertebrate? If we look at one of the higher forms, such as a pig or a rat, we may be apt to regard the tail as merely an appendage to the hinder part of the body; the animal is completely organized, and capable of living in health, without it. But as we descend in our survey to lower forms, we find the tail assume a more and more important position; till, in the Fishes, it is clearly seen to be a continuation of the main body; while the fore and hind *limbs* (that is, the pectoral and ventral *fins*) appear, by comparison, quite insignificant appendages.

The vertebrate tail, then, may be defined as a prolongation of the main axis of the body, extending behind the great body-cavity or *celome*, and the digestive canal which lies therein.

As a typical form, we may take the full-grown tail of the common tadpole, before it begins to shrink. *Fig.* 1 is a side view of this. Running through its whole length, in the middle, we find a tapering, flexible rod, around which the other parts are arranged. This is the hindmost part of the *notochord*. This notochord is one of the chief marks of a vertebrate animal; all of them have it, at least in their young state. It extends from the region of the mouth backwards; and forms the axis on which the bony vertebræ of the spine are built up. In this tadpole's tail, however, there are no bones at all.

Just *above* the notochord lies the main *nerve* of the tail; as shown in *Fig.* 2, which is a transverse section of the whole tail. This nerve is a prolongation of the great nervous axis that forms the brain and spinal cord. *Below* the notochord runs an artery, the continuation of the dorsal aorta, which brings pure blood from the gills. Beneath this again is a vein, which returns the blood towards the heart. In a *young* tadpole there are no other blood-vessels in the tail but these.

These four central organs are surrounded by muscles, which are arranged in a series of distinct segments, from the base of the tail to near its tip. Lastly, we find a thin, transparent membrane extending in the middle line all round the tail, and even a little further, along the back and front of the body itself. This is the simplest form of a *fin* for swimming in water. The whole tail is covered with a soft, naked skin. We shall find that all the wonderfully varied forms of tails, in all classes of Vertebrates, may be derived from the primitive form seen in the tadpole.

The most antiquated form of Vertebrate yet discovered is the Lancelet (Amphioxus), which is living on the sea-bottom near our own shores. This little creature cannot well be reckoned a fish,

for it has no brain, and, hardly any head to speak of; but as to its tail, it shows a slight advance on the tadpole; for it has rudiments of fin-rays to support the swimming membrane, and it also shows a slight expansion towards the end. The marginal fin extends, not only all along the back, but right round the snout in front, down to the upper lip. *Fig.* 3 is a side view of the whole animal.

Now, before proceeding to the true fishes, we may notice those most curious creatures known as Ascidians or Tunicates. These, in their young state, when just hatched, have the external shape of a tadpole. The internal structure and arrangements of the body also show some likeness; but in the tail the resemblance is most striking. See *Fig.* 4. Here we find a distinct notochord, lying beneath the nervous axis; with muscles, arranged in segments, above and below; and a vertical fin surrounding all, expanding to a fan-shape at the end. This larva swims about like an ordinary frog-tadpole. But after a time it fixes itself fast to some surface by its underside; and then the tail, no longer needed, gradually shrinks, and shrivels up. The nervous system also degenerates; the eye disappears; and the adult animal is evidently far lower in rank than the young. But there is one genus of Tunicates, called *Appendicularia*, in which this degradation does not take place; the creature keeps its tail, and swims freely all its life. It is remarkable that these Tunicates spend their whole existence in the sea; whereas true tadpoles inhabit fresh water only.

To come now to higher forms. The *Monorrhines*, which include the Hags and Lampreys, have a simple, primitive type of tail; but in the true Fishes there are several curious varieties, not only in the different kinds, but even in the same fish at different ages. Thus, in most new-hatched fishes the tail is nearly as simple as in the tadpole; but it often has an expansion at the end, reminding us of the Lancelet and the Tunicates.

Another type of fish-tail is seen in the genus *Ceratodus*, now living in some of the rivers of Australia, but found fossil in the ancient Secondary rocks of Europe. See *Fig. 5*. Here the membrane is supported by a number of jointed fin-rays, both above and below the notochord. This is called a *diphycercal* arrangement.

A more common type is seen in sharks and sturgeons, and most of the oldest fossil fishes. There are two lobes; the notochord extends along the upper lobe, which is generally the longer of the two; the lower lobe has only rays. This shows that the upper lobe is the true continuation of the axis of the body; the lower is merely part of the marginal fin. This kind is called *heterocercal*.

But the most common shape of all is that called *homocercal*; where

the whole caudal fin is stretched out on rays only. The end of the notochord turns up at an angle at the root of the fin, so as to point upwards. This kind of tail is found in most of the recent fishes, sometimes simply fan-shaped, as in the Sticklebacks; sometimes more or less forked, as in Perch and Herrings. See *Figs.* 7 and 8.

Now a very notable thing is this; that in the development of a fish from the egg, it has first a simple membranous fin, very like that of a tadpole; afterwards it becomes (in some cases at least) distinctly *heterocercal*, like the old-fashioned types of fish, before it finally assumes the *homocercal* form. For example, the common Stickleback, shortly after hatching, has a tail like *Fig. 6*. The notochord occupies the upper part, and the fin-rays are all on the lower side. As the fish grows, the notochord turns up more and more, and the end part dwindles away; so that in the adult Stickleback the upper half of the tail seems to match the lower, although nearly all the rays really spring from the *lower* side of the spinal axis.

Besides this *caudal* fin, most fishes have an *anal* fin below, on the foremost part of the tail; and the *dorsal* fin of the back often extends along the tail, sometimes joining the caudal. In the Flat-fishes, such as soles and plaice, the vital organs occupy a very small part of the animal; the rest is all tail, with its continuation in the high ridge of the back. In these flat-fishes the roe extends backward far into the tail.

The bony skeleton of a fish's tail consists of a series of vertebræ along the notochord; each vertebra carrying a *neural* arch above, to protect the nervous cord, and a *hæmal* arch below, covering the great blood-vessels. Both these arches are often prolonged into spines at top and bottom; as is well seen in the Flat-fishes. Among the curiosities of fish-tails are the *prehensile* tails of Pipe-fishes and Sea-horses, by which they anchor themselves among seaweed. Also the strange whip-like tails of Skates. rather suggestive of *mammalian* tails than any other class. In early life, however, the Skate's tail is of the ordinary tapering form.

Above the Fishes come the *Amphibia*, including the Efts, Frogs, and Toads. All these in their early stages have tails such as already described in the tadpole. The efts keep this primitive tapering tail all their life, with neural and hæmal arches as in Fishes. The fin reaches round the back as far as the neck; but never acquires any fin-rays, or specialized tip. When the animal takes to the land, the fin disappears, being no longer needed.

In the frogs and toads the whole tail is gradually absorbed. The white corpuscles of the blood carry it back into the body particle by particle, thus nourishing the tadpole during its great

transformation. The full-grown Frogs and Toads are of all Vertebrates the most absolutely taillest. Hence they are called *Anura*; that is, "without tails."

There is a remarkable fact about these temporary tails. The notochord in them remains, without any ossification, as if it were not worth while to grow them; whereas in the permanently tailed amphibians, such as the efts, the bony spine extends along the tail.

In *Reptiles* the tail is very often massive, and clearly a continuation of the trunk; still being used as a swimming or wriggling organ. Some kinds of lizards, when seized by the tail, throw it off; or rather, it is broken off by violent muscular action. Our common Lizard, and also the Slow-worm, have this habit. It has been thought to be useful to the animal; inasmuch as the violent wriggling of the loose tail may attract attention, while the body runs away.

Some lizards, as the one called Basilisk, have a crest on the back and on the tail. The tendency to the formation of this may possibly be inherited from their amphibian or fish-like ancestors, which had a dorsal fin.

A prehensile or grasping tail is found in the Chamæleon tribe, and in many snakes. The Slow-worm has a tendency that way. On the other hand, the Tortoises have comparatively short tails.

Perhaps the most singular modification in Reptiles is the rattle of the rattle-snakes. This consists of several loose rings of skin, and is sounded by shaking the end of the tail. There is a rudiment of it in some other snakes.

One kind, that has *no* rattle, was observed by Darwin, shaking its tail like a true rattle-snake, so as to make a noise by striking against the grass, &c. This gives us some clue as to the way in which the rattle may have originated. As to its *use*, it has been suggested that the sound may serve to warn predacious animals of the dangerous nature of their intended victim, and so save it from attack.

From the Reptiles let us pass to their modified relatives, the Birds. Although the modern bird's tail is the greatest possible contrast to the long scaly one of the lizard, yet one of the "missing links" is still to be seen in the fossil *Archæopteryx*. This extinct creature had a long, tapering, jointed tail, like a lizard; but each vertebræ bore a pair of large quill-feathers spreading horizontally. These feathers on the tail, with those on the wings, were very likely the only ones it possessed. See *Fig.* 9.

In the birds of the present day the caudal vertebræ are few, and very short; the last are joined together into the so-called "plough-share bone," which supports the whole set of quill feathers. The

variety of form in birds' tails is due to the arrangement of these feathers, which are merely extensions of the outer skin, rather than to any difference in the inner framework.

Birds, as a class, are noted for their æsthetic faculties; they have an eye for the beautiful. Hence we find various forms of purely *ornamental* tails, often belonging to the male bird only. Such are those of some kinds of humming-birds; also that of the male of the Australian lyre-bird. In the common fowl, the cock has a specially ornamental tail. But the strangest kind of adornment is that practised by the Motmots of South America. These birds artificially beautify (as they fancy) their own tails, by picking off parts of the feathers with their beaks, according to a certain fashion of their own invention.

In some birds the tail is specially modified for use, not ornament. Thus, in Woodpeckers it serves as a prop in climbing trees; the end of the quills being stiff and pointed, to catch against the bark. The very same thing occurs in the Creepers, which belong to a different order, quite separate from the Woodpeckers.

The tails of *Mammals* are built on the same plan as those of the lower Vertebrates; but the bones are mostly simplified; for the spinal cord stops short, and the neural arches often extend only a short distance down the tail. The skin is generally covered with hair. But they differ very much from each other, according to the different uses to which they are put. Thus, the Kangaroo has a think muscular tail, which supports the animal in an upright posture, and helps it in hopping. The African Aard-vark and the scaly Pangolins have likewise thick tails, like those of Reptiles. In the Otter we see a return to the original function of the tail; it is flattened, so as to form a swimming organ. In the Beaver, and also in the Whales and Porpoises, it is flattened out in the opposite direction, namely, horizontally.

A common form of tail among land mammals is the long furry or bushy kind, which has various uses. In the Cat and Dog it seems to serve as an outlet for emotion, and a means of expressing the feelings. In some breeds of Sheep the tail has become a mere reservoir of fat, like the hump of a camel. In the Squirrel it has a singular use, as an overcoat or parasol. The word "squirrel" is a diminitive of the Latin *sciurus*, which comes from the Greek *skia*, a shadow, and *oura*, a tail; so the name "squirrel" means "little shadow-tail." The great Ant-eater has an enormous development of hair on its tail.

Another shape of tail is the long and thin, with a tuft at the end; seen in the Ox, Donkey, Camel, and Giraffe. This is often very useful to drive off the flies. But in some jumping animals, as the Jerboas, it acts as a balancing-pole.

Often the tail is thin and nearly naked, as in Rats and Mice. These tails are always of use to balance the body; but in some cases there is a further development; the end of the tail has a grasping power, and becomes prehensile. Many of the South American animals have these grasping tails, by which they can hang from the branches of trees. Some of the Oposums have an odd habit of carrying their young ones on their backs; and the little ones twine their tails round their mother's tail to keep themselves steady.

In many kinds of Bats the bones of the tail help to support the flying membrane, which extends between the legs. In some other kinds of Bats the tail actually passes through a hole in the membrane to the upper side.

Lastly, some mammals have the tail quite short and rudimentary, so as even to be invisible externally. This happens in many different orders of mammals. Among the Australian marsupials, there is the Wombat; among rodents, the Guinea-pig; among hoofed animals, the Peccary. A few of the highest apes, such as the Gorilla and Chimpanzee, are as tailless as Man himself. But even in the human skeleton a tail is clearly to be seen, composed of several vertebræ soldered together to form the bone called the *coccyx*. In Man, as in all other short-tailed Vertebrates, the tail is much longer, in proportion to the body, at an early stage of development.

The tail of Vertebrates may therefore be traced through all the different classes, changing wonderfully from the original shape, as a backward prolongation of the body, bordered by a fin, used for swimming in water. But yet all the forms, whatever uses they are put to, whether highly developed or quite rudimentary, may be viewed as directly descended from a swimming organ, like that of the common tadpole

The paper was illustrated by diagrams showing the development of the tail throughout the various classes of the animal kingdom. A vote of thanks was passed to the writer.

Mr. Walton exhibited some lichens, and also a specimen of the fruit of *Sagas amicarum.*

March 10th.

The snowfall was so heavy and persistent that the meeting was necessarily postponed.

APRIL 14TH.

The following paper was read by the President :—

ON GERMS.

There is perhaps no topic which has excited greater scientific interest and provoked warmer discussions than the so-called Germ Theory, or the influence of micro-organisms in the economy of nature and the causation of disease. The investigation of the infinitely small has always exercised a wonderful fascination over the minds of scientists, who ever desire to trace back step by step all life to a first cause—a primeval atom—and to follow all the tortuous windings of disease until the actual origin is found, the first germ, the infinitesimal molecule. Bacteriology, or the study of these minute organisms, is, however, too vast a subject to be adequately treated in the short space allotted to me. I merely propose this evening to touch upon a few of the more interesting points connected with this science, especially as illustrated by the discoveries of that great chemist and scientist, M. Pasteur. There is no other living man who has done more to benefit society by his patient and laborious investigations into the origin of disease, which, thanks to his indefatigable zeal, may be said to have revolutionised the whole science of medicine and surgery.

The manner in which M. Pasteur's labours were directed towards this special subject of bacteriology is not perhaps generally known, and it is somewhat interesting as illustrative of the homely proverb that "small beginnings make great endings."

Some forty years ago the minds of many eminent chemists were greatly exercised by the incomprehensible behaviour of the so-called 'isomeric bodies,' viz., compounds which, though possessing an identical composition, appear, to judge by their chemical action and optical properties to be totally different substances. The great Swedish chemist Barzelius, and later on Biot, vainly endeavoured to solve the problem why two acids which were constituted alike had altogether dissimilar properties. I refer to the ordinary tartaric acid of wine-lees which possesses the power of deviating the plane of polarised light to the right, and a rare acid found occasionally in the tartar deposited from wine made in the Vosges district, and which is optically inactive. This perplexing question attracted the attention of the then unknown Pasteur, and for seven years this indefatigable chemist proceeded with his experiments, which were ultimately rewarded with success. He discovered that the rare acid itself was made up of two compounds which were identical in composition but differed

in their optical properties, one being the already-mentioned tartaric acid which rotates the plane of polarisation to the right, the other being a new acid which turns it to the left, thus the optical properties of the one exactly neutralise those of the other, so that the rare acid is optically inactive. M. Pasteur found that the two acids thus combined in the rare acid were capable of separation by means of a ferment, the minutest trace of which sets up decomposition in this acid, destroying the common tartaric acid, but leaving unchanged the new and rarer laevorotatory acid. The discovery of this one special ferment, which was the result of seven years' toil, was but the precursor of all those marvellous revelations of the nature of ferments which had previously baffled all chemists, and especially those connected with the processes of wine-making and brewing. These discoveries led eventually to the higher study of bacteriology in connection with infectious diseases to which man and the lower animals are subject.

Until the year 1857, fermentation was regarded as a somewhat mysterious process, by which a solution of sugar was transformed into alcohol, and alcohol sometimes became vinegar, but that the process of fermentation was due to any specific organism was hitherto quite unsuspected. M. Pasteur, however, succeeded in tracing and identifying distinct and different organisms which cause the several varieties of fermentation. By adding the faintest trace of the acetous ferment to sound wine, he showed that it rapidly developed, turning the wine into vinegar. Or, again, milk which was perfectly sweet was in a short time turned sour by the addition of a mere trace of the lactic acid ferment. Thus, the individuality of the various germs was proved, for the lactic ferment will not cause acetous fermentation, nor will the alcoholic ferment give rise to lactic fermentation. Then arose the question, How is it that fermentation often appears to arise spontaneously, and that milk turns sour after simply being exposed for some hours to the air? On this point arose a violent controversy, which raged for many years, the principal exponents of the two theories being M. Pasteur on the one hand, who maintained that spontaneous generation was impossible, and Dr. Charlton Bastian on the other, who asserted that its possibility had been clearly proved.

M. Pasteur claimed that grape juices, brewers' wort, milk, beef-tea, or any other decomposable liquids would remain for an indefinite time unaltered if boiled and placed in sterilised tubes, namely, those from which all germ-laden air is absolutely excluded. In support of this theory, M. Pasteur placed some beef-tea (a highly decomposable liquid) in a tube with a long narrow neck, in which tube he boiled the liquid; then by an ingenious contrivance which still kept the neck of the tube red hot, so that all germs were

burned and destroyed as they entered, he allowed the air to have free access to the tube. Beef-tea kept in this manner was found at the expiration of some months to be perfectly sweet, but when the neck of the tube was broken off and boiling heat no longer maintained, the liquid was quickly decomposed, and in twenty-four hours swarmed with bacterial life. Thus was demonstrated the fact that decomposition is due to the micro-organisms which throng the air, and not to any power of spontaneous generation in the liquid itself.

Dr. Bastian, however maintained that by his experiments it was equally well proved that a decomposable fluid placed in sterilised tubes, boiled, and then hermetically sealed, was capable of setting up spontaneous generation. The balance of scientific opinion was, however against him, and M. Pasteur's theory was fully confirmed by Professor Tyndall, who showed by many elaborate experiments that the most decomposable liquids, if first sterilised by boiling, and then effectually secluded from the air by cotton wool, would keep good for an indefinite period. He also demonstrated that if, after being boiled, they were simply kept at an extreme altitude, where the air is free from germs, they are equally proof against decomposition.

These experiments are, to my mind, deeply interesting, for I confess I am one of those who cannot believe in the chemical origin of even the lowest forms of life. I believe that even in the very humblest organism exists a vital power, not only different from, but, as we see in our own bodies, even opposed to chemical action. We may not be able to define this marvellous power, or to say in what it consists, but we see and feel its might, and our own minds recognise it as that breath of life which emanated from a supreme being. Life can never be a mere heterogeneous collection of atoms; there must be some guiding influence, directing each tiny particle to the place it is to fill in the grand and harmonious scheme of nature. Nothing in creation is more calculated to excite our emotions of wonder and awe than the knowledge that two tiny molecules of precisely similar appearance are destined, perhaps, to develop, the one into a sentient and immortal man with all his wonderful apparatus of ever beating heart, active and reflecting brain, and complex organisation, and the other into merely a simple lichen clinging to some weather beaten stone.

M. Pasteur having identified the special fungus or yeast ferment which transforms brewers' wort into beer, he was able readily to detect, by the aid of the microscope, the other germs which so frequently turned the beer sour, and spoiled the brewing. These injurious microbes with which the air of a brewery teems in consequence of the decomposable nature of many of the materials used,

are thus often accidentally introduced into the wort, as well as the pure yeast ferment, and however well and scientifically the brewing is otherwise managed, the result is inevitably to ruin the beer. M. Pasteur found that heat of a temperature considerably below boiling point was fatal to these poisonous germs without being in any way injurious to the beer. Thus by a scientific microscopic test at the various stages of brewing, and a subsequent application of the requisite heat, the possibility of the beer becoming sour was reduced to a minimum, if not entirely abolished, and an operation which was previously carried out at great risk, and with frequent loss of capital, was thus placed on a firm and scientific basis. A microscope has now become as important an item in a brewhouse as a thermometer. M. Pasteur's researches were of no less value to wine manufacturers, for having once identified the germs which cause acetous fermentation, he was able to determine the exact degree of heat fatal to them, and was thus the means of materially benefiting the wine trade of the whole of France.

M. Pasteur's attention was next turned to a disease seriously affecting another, but equally important, branch of industry in his own country.

Some thirty years ago, the silk weaving trade which is carried on in the south of France to the value of some millions sterling annually, was threatened with extinction, in consequence of the silk worm disease called Pebrine, from the black spots which develop on the bodies of the grubs. When at last, after much reluctance and with great modesty, M. Pasteur undertook to investigate the nature of this disease, many scientists openly ridiculed the idea of a mere chemist venturing into the special domain of the biologist. Nothing daunted, however, M. Pasteur proceeded with his experiments, and in a few months formulated his theory respecting the disease. Other scientists had already traced micro-organisms in the blood and tissues of the diseased worms and moths, but they were unable to solve the problem why apparently healthy eggs developed into diseased worms, and why certain diseased worms yielded normal cocoons. The difficulty was solved by M. Pasteur. He found that moths derived from diseased worms never lay really healthy eggs, although in consequence of the minuteness of the germs they may escape detection in the eggs or in the newly hatched worms, the disease only developing with the growth of the worm, and thus rendering it incapable of spinning a cocoon. In this disease the microbes completely fill the silk weaving organs of the grub and destroy the clear, viscous fluid from which the silk is spun M. Pasteur found, moreover, that the disease is highly infectious as well as hereditary, and that worms so infected were capable of spinning cocoons, although they were so far impregnated

with the disease, that, when developed into moths, they invariably laid diseased eggs, which in their turn would yield no cocoons. Here then was the solution of the problem—worms in which the disease is inherited spin no cocoons, and can, as moths, lay only diseased eggs; worms in which the disease is contracted and not inherited, can spin cocoons, but only yield diseased eggs. Here, as in all M. Pasteur's discoveries, the aid of the microscope is indispensable, and by careful examination of the worms, moths, and eggs, it is easy for the diseased specimens to be identified and destroyed, and the disease may thus be practically stamped out. So successful indeed has been the application of M. Pasteur's tests, that the silk industry is once more flourishing, and Pebrine is, comparatively speaking, a disease of the past.

But a still greater task awaited M. Pasteur in elaborating his experiments as to the possibility of weakening the virus of specific microbes, and thus placing preventive inoculation on a scientific basis. In the course of his experiments with ferments, M. Pasteur had first discovered the possibility of separating and cultivating any special germ in some suitable broth or liquid, much as a gardener raises some special seed in a particular soil. His attention was first directed towards the subject of infectious diseases and preventive inoculation, by the prevalence of a disease called chicken cholera, caused by poisonous microbes in the blood and tissues of the diseased fowls. M. Pasteur succeeded in isolating and cultivating this specific germ without weakening its poisonous properties, but he also found that by exposing it for some time to the air, and subjecting it to a certain degree of heat, it was possible so to weaken its virus that a chicken inoculated with this attenuated lymph was made only slightly ill. This mild attack, however, caused by the weakened virus, renders the fowl proof against the more deadly disease. This brilliant discovery that the virus of these micro-organisms is alterable at will, and can be cultivated up or down to any degree of virulence, is of incalculable value, and affords the clue to the theory of preventative inoculation, which may possibly in time be the means of providing us with a scientific method of protection against all infectious diseases. It is an interesting question whether the varying strength of the virus of infectious complaints may not possibly account for the variable strength of the attacks, a variety of circumstances conspiring either to preserve or to weaken the poison.

M. Pasteur's next subject of investigation was that fatal disease called anthrax, charbon, or splenic fever, which in severe cases often kills cattle and sheep in twenty-four hours. In one district of Russia alone, between the years 1867 and 1870, no less

than five-hundred and sixty-eight persons, and fifty thousand animals perished from this fell disorder. Here again M. Pasteur detected the special fungoid growth or bacillus, which produced these disastrous results, and found that by cultivating the germs in different media, he was able so to weaken or modify their virulence, that vaccination with this attenuated virus protected healthy animals from a severe attack of the disease, without seriously affecting their health.

In a celebrated test experiment, which was watched with the keenest interest by scientists as well as by many practical men, M. Pasteur inoculated twenty-five sheep out of a flock of fifty, and after their recovery from the slight illness thus produced, he publicly inoculated the whole flock with the ordinary virus of anthrax. The result was precisely in accordance with his predictions; within forty-eight hours the twenty-five uninoculated sheep were dead, while those which he had previously inoculated with the weakened virus, were alive and well. No less than one million seven hundred thousand sheep, and ninety thousand oxen, have been vaccinated with the preventative virus during the last few years, the result being that the mortality from this plague, which formerly averaged ten per cent., has been reduced to less than one per cent. The system of preventative inoculation is now universally adopted in all those districts in France where anthrax was formerly prevalent.

But, perhaps, M. Pasteur's most brilliant achievement is in connection with his experiments for the prevention of the awful disease called rabies, for, although he has not yet identified its special bacillus, he has found that by cultivating and weakening the virus of the disease, a lymph is produced, with which he believes dogs or other animals may be effectually protected by vaccination from rabies. He has also greatly advanced our knowledge of this dire disease, for whereas the poison was formerly supposed to exist only in the saliva of the rabid animal, M. Pasteur has traced it definitely to the nerve centres. An animal inoculated with virus from the spinal marrow of a rabid animal developes the disease far more rapidly than one inoculated only with the saliva. The fact that the nerve centres are the seat of the disease goes far, according to M. Pasteur, to explain the cause of his anti-rabic treatment not being invariably successful. The length of time occupied by the virus from the tooth of a rabid animal in reaching the nerve centres varies according to circumstances, and should the central nervous system be affected before the inoculation with the weakened virus takes place, the latter is of course valueless. The difference of opinion on the Pasteurian method of dealing with the rabies is very great, and the various arguments for and against

it are too lengthy to find a place in this short paper. Suffice it to say, that of the cases treated annually by M. Pasteur, and which average from fifteen hundred to two thousand, the mortality is only 1.16 per cent., a very striking result, when we consider that without treatment, the mortality among persons bitten by rabid animals is from fifteen to twenty per cent.

In my own opinion the element of uncertainty as to the success of the treatment is very great, and few of us, I imagine, would care to be inoculated with even attenuated rabic virus. It is therefore a race, so to speak, between the strong and the weakened poison, and the result necessarily depends greatly upon the situation of the bite, and its proximity to the nerve centres. The risk of infection from the bite of a rabid animal is of course enormously greater if the person is bitten on a naked surface, such as the face or hand, as the virus is almost sure to be wiped off the tooth if the sufferer is bitten through the clothes. I should like to mention, though it hardly belongs to the subject, that common lunar caustic is not a good remedy, but that a strong solution of corrosive sublimate, or even carbolic acid, is much more effectual in destroying the germs of rabies.

To M. Pasteur, among others, we are indebted for the knowledge that infectious disease is due not so much to the presence of the microbes themselves, as to specific poisons which they generate in the system, and which are of the nature of poisonous alkaloids or ptomaines. The chemical action produced by these microbes in the system is analogous to the action of the yeast ferment on beer or wine; the method, however, in which this action is produced is at present unknown. If the diphtheritic bacilli, for example, are cultivated, the chemical poison which they generate may be separated from the microbes themselves, and one drop of this poison injected into an animal is as fatal in its results as inoculation with the diphtheritic bacilli; a conclusive proof that it is the poison generated by the micro organism, and not the microbe itself, which causes the disease.

All micro organisms are classed under the generic terms bacteria, microbes, and germs, and are of a vegetable nature, minute species of fungi; they consist of the plant itself or germ, and the seed or spore, which latter is of an especially hardy character, and is far more capable of resisting the action of germicides than the parent germ. Germs are of a very elementary structure, propagated either by means of spores or by a process called fission, that is to say, the parent germ divides and forms two germs, which are again capable of subdivision. The speed with which these germs multiply is truly marvellous, and is said to be at the rate of a hundred thousand, or even more, in a single hour. It is estimated that the

air of towns swarms with these germs to the amount of nearly two thousand to every cubic foot, while in pure country, mountain, or sea air, their presence can hardly be detected. The soil itself, to the distance of some feet below the surface, swarms with germs, and they are also found in the walls of our houses, the clothing we wear, the food we eat and the drink we consume, and even on our books and our money. I need hardly say that the great majority of these germs are, fortunately for mankind, of a comparatively harmless kind.

It is suggested that to the presence of these micro-organisms in the air is possibly due the summer catarrh or hay fever, which is the result of some irritation of the mucous membrane of the nose and respiratory passages, and has hitherto been attributed to the pollen of grasses.

The vitality of some germs, and especially of the young spores, is very remarkable; thus tuberculous bacilli, found in the sputa of phthisical patients, which has been dried and kept for some months, are as capable of communicating infection as those which are quite fresh. Some of these spores are even capable, under favourable circumstances, such as dry soil, &c., of retaining their vitality and virulence in a latent condition for enormously lengthy periods —for hundreds or even thousands of years; and may then under suitable conditions of heat and moisture break out into renewed life and power. Dr. Maljean has lately published an account of some interesting experiments on germs discovered in the fluid collected from a wind instrument used some time previously by a phthisical musician. These germs were found to have fully retained their infectious properties.

Heat is far more fatal to germs than cold, even if the latter be as low as the freezing point; whereas heat at boiling point (212 deg. Fahr.) kills any microbes with which we are at present acquainted. Next to heat, corrosive sublimate is the most effectual germicide we know, but owing to its highly poisonous character, either when used internally or upon a raw surface, it can only be sparingly used in cases of illness. Carbolic acid, which is also a caustic poison, is an effectual germicide, but less powerful than corrosive sublimate. It is the poisonous nature of most germicides which prevents their internal use as remedies for those diseases due to the agency of microbes, for their action would be as fatal to the whole system as to the germs themselves. The most effectual method, therefore, of combating these poisonous germs is from without, and thus preventing their entrance as far as possible into the system. It is this principle which underlies the antiseptic treatment inaugurated by the celebrated Scotch surgeon, Sir Joseph Lister, which marks a new era in surgery, and has already been the means of

saving many thousands of lives. Health can only be attained by thorough cleanliness, both personal and chemical, and by adopting all proper sanitary precautions in our houses and our towns. All poisonous germs thrive in darkness and in dirt, but are speedily put to flight by sunlight, pure air, and pure water. Indeed the virulence of some known germs is practically destroyed simply by exposure to the light, thus affording a fresh proof of the supreme importance of allowing sunlight to enter and purify our houses.

It was formerly, but erroneously, supposed that microbes were minute bodies of a very low form of animal life. This idea arose from the fact that they are capable of spontaneous movement. They are, however, of vegetable nature of the fungus tribe, closely allied to those minute vegetable organisms known as amœbæ (from their inherent power of changing their shape), and to the infusoria met with in stagnant water. Many years ago both amœbæ and infusoria were described as animalculæ, but now that microscopic observations are made with much greater accuracy, the vegetable nature of these minute organisms has been clearly proved. Most germs are capable of motion, and some appear able to avoid or to free themselves from contact with other bodies. Their usual method of propulsion is by means of a minute point at either end of the body, called a flagellum. All germs are commonly termed bacteria, although the name baterium (a little staff) is really only applicable to the oval species, of which alone there are over fifty varieties. The long, thin, rod-like germs are called bacilli (bacillus, a little rod), and include forty different kinds. The round germs or dots are known as micro-cocci (micro-coccies, a small kernel), and number over eighty varieties. In addition to the three principal species of germs already mentioned, there are the spirilli, curled hair, or spiral-shaped germs, the streptococci (twisted kernels), and the staphylococci (grape-like kernels).

Many microbes have already been identified as causing specific forms of disease, and although the study of bacteriology is at present only in its infancy, it is believed by many scientists that every infectious disease is due to some special germ. Already the specific microbes of pneumonia, phthisis, diphtheria, cholera, leprosy, and ringworm have been identified, separated, and cultivated, while those to which it is believed that typhoid fever, erysipelas, and various other infectious diseases are due, are at the present time under examination. It is a remarkable fact, and one to which I have already alluded, that with all infectious illnesses, *i.e.*, those caused by poisonous germs, that one attack, be it ever so slight, has usually the effect of conferring immunity from a recurrence of the same malady. Hence, inoculation with the weakened virus of an infectious disease may be considered a

prophylactic against a second or more acute attack of the same complaint. It is believed by some that during the first attack the system has been permantly exhausted of the nutriment necessary to the existence of the germs of that special disease. On this point hinges the whole theory of preventive vaccination. This is a subject which interests not only doctors but the world at large, for if animals can be protected by inoculation from fowl-cholera, anthrax, and rabies, it is quite possible that when the science of bacteriology is better understood, mankind may be exempted from all such diseases as phthisis, diphtheria, scarlet fever, cholera, and indeed all those caused by poisoning germs.

As you all know, Dr. Koch professes to have already found the curative injection for phthisis, and it is on the principle of protective inoculation that his treatment of consumption is based. Koch claims that his injection, which is a glycerine extract of a pure cultivation of the tubercle bacilli, produces a destructive influence on the diseased or tubercular portion of the lungs or other parts, and that in consequence the especial bacilli to which phthisis is supposed to be due can no longer find sustenance there. He states explicitly that it does not poison or destroy the bacilli. During the four months which have elapsed during the announcement of his discovery, many thousands of people suffering both from lupus and consumption have been injected, but the result has not proved satisfactory, as very few cases of cure are even claimed, and there have been very numerous deaths from the treatment, while in a great many cases the patients have been made much worse, and slight cases of phthisis have been converted into galloping consumption. This is a great disappointment both to the public and the profession, who had but too confidently accepted the truth of the great scientist's assertion, that his treatment would cure consumption in its earliest stages. I have the greatest respect for Professor Koch as a scientific chemist and an earnest pioneer in the deeper mysteries of science, but I can but deplore that he was so unfortunately advised as to introduce his remedy in a manner so little in accordance with the traditions and practice of scientific men of this country.

Koch's fluid or tubercular as it is now called, was, until quite recently, to all intents and purposes, a secret remedy, and even now, he has only told us what it is, without giving such details as would enable English chemists to manufacture it for themselves. Tuberculin is an animal poison of the nature of a ptomaine, more powerful than almost any known drug, and its injection is usually followed by grave and violent symptoms, such as fever and inflammation, sometimes delirium and other signs of profound disturbance of the system; it is undoubtedly a treatment which

should not lightly be undertaken or undergone. It is, of course, a source of scientific congratulation that so many persons should be not only willing, but anxious to be operated on, but they should, I think, be explicitly informed by doctors that the treatment is only in the experimental stage, that its curative effect is far from certain, while its dangers are grave and numerous. With the exception of Pasteur's experiments for hydrophobia, it is the first time that experiment on the human subject has been sanctioned by the public, and I doubt very much if they knew more of the subject whether they would so cheerfully submit to it. Various theories have been suggested to explain the method by which poisonous germs develop in the system, and there generate chemical poisons. There is no doubt a continual struggle is taking place in the system between the healthy cells in the blood and tissues of the body, and the poisonous germs which we unconsciously breathe in with the air and swallow with our food. In a perfectly healthy body the foreign germs seem to be actually devoured and digested by the white blood corpuscles, and are rendered absolutely innocuous. But in caseswhere the system is unhealthy or enfeebled, the poisonous microbes become in their turn the attacking party and destoy the blood cells, consume their nutriment, and finally generate a chemical poison which effects the whole system and induces illness. This at least is the theory of Metschnikoff, Armand, Ruffer, and others, though I must tell you it is vigorously contested by other scientists. This struggle or battle between the healthy cells and the intruders has been admirably depicted by M Metschnikoff who has not only (microscopically) witnessed this conflict, but has made excellent diagrams of the result of his observations. In the diagrams now before you, copied from M. Metschnikoff, may be seen the intrusive germs beset, devoured, and actually digested by the blood cells, while in some may be seen a blood cell attacked and destroyed by the microbes.

The amœboid cells, whose beneficent functions it is to prey upon and devour inimical germs, are termed phagocytes (Gk. phagein, to eat); they are subdivided into macrophages, large or tissue cells, and microphages, small cells. In an interesting article by Dr. Alfred Schofield on this subject, he tells us it is believed that the process by which a tadpole loses its tale is due to the voracious instincts of these phagocytes, and those germs which prey upon all dead organic matter, and which commence their work the moment that life is extinct. It is a remarkable fact that during life the animal body is able to defy those special microbes known as decay-producing bacteria or saprophytes.

Dr. Armand Ruffer has published some highly interesting notes of investigations made by him concerning the conflict between the

healthy blood cells and unhealthy germs which takes place in the diphtheritic membrance. He shows that the diphtheritic microbes, which are present in enormous numbers in the superficial layer of the false membrane, are hardly discernible in the succeding layers, and are entirely absent from the lowest layers of the false membrane. Moreover, many of the amœboid cells or leucocytes in the layer of the false membrane immediately below the superficial layer are seen to contain two or more of the diphtheritic bacilli which they have evidently attacked and partly destroyed. Dr. Ruffer adds, "the diphtheritic membrane is a battle-field for amœboid cells and the pathogenic microbes of diphtheria. The reason why the bacilli do not penetrate into the tissues is probably that as soon as they do so, they are arrested by the amœboid cells present in the diphtheritic membrane." Dr. Ruffer confirms the opinion of many eminent bacteriologists, that a constant warfare is ever taking place within us, between healthy cells and unhealthy germs, and just in proportion to our health and vigour, are we able to resist and overcome these insidious foes.

Not animals but plants are attacked by these parasitic fungi, and the "blight," "mildew," and "mould," with which we are all familiar, and with which plants are so often affected, are all due to the depressing agency of some specific micro-organism. Professor Soraner, who is an authority on the diseases of plants, ascribes the potato blight which was so prevalent last autumn to a bacterium termed "clostriplum batyricum" (which you see depicted on this diagram). This germ "is able to dissolve the cell walls (of the potatoe), and to develop butyric acid"; if the diseased tubers "are at once put into a dry, light place, the vegetation of the bacteria is arrested," but is left unexposed to the air, "the potatoe will rot away into a thin, dirty liquid, held together by the skin." Here again is a proof of microbes flourishing in darkness and in damp, but withering away if exposed to the beneficent rays of the sun.

We hear and read so much of the disastrous influence of germs that we scarcely realise the inestimable service rendered by bacteria in changing and removing the products of decay and death. They literally regenerate the world by devouring the debris of dead organic matter, and reducing it by decomposition, into its original harmless components. Were it not for their salutary influence in revolving all dead and putrescent materials into their original elements, the world would long ago have become one vast charnel house, unfit for human abode. Indeed, life itself would have become impossible were it not for their agency, for the whole surface of the earth would be filled with the noxious remains of every type of organic matter, both animal and vegetable. Hence

these really beneficent, though apparently deadly microbes, play a very considerable part in the economy of nature, and have been not inaptly termed the "Scavengers of the Almighty."

A short discussion ensued at the close of the paper, and the usual vote of thanks was passed. A number of good diagrams illustrated the lecture.

May 12th, 1891.

A combined meeting with the Microscopical Society took place at which a goodly number of objects were shown and described. The Secretary was absent through illness.

October 20th.

The first meeting of the Session was held, the President in the chair.

A discussion took place on the desirability of amalgamating the Microscopical and Natural History Societies. Several members of each society had many times expressed a wish for this, and the President and Secretary each pointed out the advantages which would accrue to both societies becoming one. The Secretary of the Microscopical Society (Mr. Kerr) said he thought it very desirable, and that his committee was waiting to see the results of this meeting.

It was then proposed by Mr. Walton and seconded by Mr. Ellis:—That a communication be forwarded from the Natural History Society to the Committee of the Microscopical Society inviting them to take steps for the desired amalgamation. Carried unanimously.

Mr. Kerr then read a paper on "The Hessian Fly," which was full of information and exceedingly interesting. It was illustrated by good diagrams and a large number of Microscopical preparations which were exhibited at the close. A vote of thanks to the lecturer was passed.

TUESDAY, NOV. 24TH, 1892.

The usual monthly meeting, unavoidably postponed from the 10th was held. Twenty members and their friends were present. A paper on THE SOLANACEÆ was read by the Secretary, illustrated by specimens and diagrams.

Mr. Walton exhibited various specimens of Fungi and of the local Solanaceœ.

Mr. Billinghurst placed on the table the Butcher's Broom (*Ruscus aculeatus*) in both blossom and fruit.

Dr. Thomas Eastes lent Gerarde's Herbal.

The lecturer brought Culpepper's Herbal.

Miss Rutt a volume of British Wild Plants (hand painted) with a number of seed cases, &c.

Mr. Walton who occupied the chair, made a few additional remarks. A countryman had once brought to him a massive root of Bryony weighing 13½ pounds, believing it to be the mandrake.

List of Societies.

(WITH WHICH WE EXCHANGE PROCEEDINGS.)

The Scientific Association, Meriden, Conn., U.S.
The Academy of Sciences, New York.
The Academy of Sciences, Philadelphia.
The Elliott Society of Science and Arts, Charleston.
The Rochester Academy of Science, Rochester, N.Y.
The Imperial German Academy, Halle-on-the-Saale.
The Tunbridge Wells Natural History Society.
The Huddersfield Naturalists' Society.
The East Kent Natural History Society.
The Brighton and Sussex Natural History Society.
The Eastbourne Natural History Society.
The Harrogate Natural and Scientific Society.
The Geological Society, Glasgow.
The Philosophical Society, Glasgow.
The Manchester Microscopical Society.
The Oldham Microscopical Society.

Their publications can be seen on application to the Secretary.

Folkestone Natural History Society.

Established 1868 for the purpose of spreading the knowledge and love of Natural History, and for working out the productions of the immediate neighbourhood of Folkestone.

Evening meetings are held on the second Tuesday of each month, from October to June, at which papers are read and objects are exhibited. During the summer one or two field excursions are taken.

The subscriptions are of two classes, one Five Shillings per annum, the other Two Shillings and Sixpence. Anyone wishing to join should communicate with the Secretary, at Sea View Villa, Folkestone.

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NINTH SERIES.

PROCEEDINGS

OF THE

FOLKESTONE

Natural History Society.

For the Year 1892.

FOLKESTONE:
J. English, Printer, 31, High Street.

FOLKESTONE

NATURAL HISTORY

AND

MICROSCOPICAL SOCIETY.

PROCEEDINGS.

NINTH SERIES, 1892.

Tuesday, February 16th, 1892.

It was found impracticable to hold the Annual Meeting in January, owing to the prevalence of so much sickness. And on this evening it was found necessary through the illness of the President and Secretary, again to postpone it until March.

Several microscopes were on the table, and a number of interesting objects were shown. There were 23 members present, and two new ones were elected.

March 1st, 1892.

The Annual Meeting was held. The weather was very inclement, and only 19 were present, The Secretary read the Balance Sheet, which showed a balance in favour of the Society of £15 7s. 10d. (see end of proceedings).

He then read the following Report for 1891—

The number of Members on our roll at the end of last year, was seventy-nine, a smaller number than we have recorded for many

years. Three during the year have been removed by death, viz.: W. Bateman, Esq., and Messrs. May and Jarvis. During the past few weeks, however, of the present year we have also lost the Rev. E. Heel.

I have laid the Balance Sheet for the year on the table; it shows a balance in hand of £15 7s. 10d. The smallness of the subscriptions is owing to the fact that only one half of them have been paid in as yet.

During the year we have had six meetings, viz.:—

JAN. The Annual Meeting when the President gave his usual resumè of the progress of Science during the year.

FEB. When a very interesting paper by H. F. Rutt, Esq., "On Tails," was read by the Secretary.

APRIL When the President read a paper on Germs. The March meeting could not be held in consequence of continuous snowstorms.

MAY Combined meeting with the Microscopical Society.

OCT. Paper by Mr. Kerr on the "Hessian Fly."

NOV. Paper by the Secretary on The Natural Order Solanaceæ.

All these meetings have been very poorly attended, and have greatly disappointed those who had to prepare papers for them.

In consequence of a widely spread wish among the members of our Society and the Microscopical Society, meetings of the committees have been held, and arrangements have been made for the amalgamation of the two under the title of the "Folkestone Natural History and Microscopical Society," under conditions presently to be read to you, and to which your sanction will be asked. It will be an advantage to both Societies and will allow perhaps a little greater variety in our arrangements.

The President, Dr. FitzGerald, then read the following paper on

THE PROGRESS OF ASTRONOMY DURING THE LAST FEW YEARS.

In reviewing the events of the past year, no brilliant invention, no absolutely novel discovery can be recorded. Our scientific workers have been as diligent as ever, and as regards the quality and thoroughness of their work, each year doubtless shows some advance. Still, the year 1891 will be memorable for none of those startling inventions, which from time to time, have electrified the whole civilised world. The progress of science, though sure and irresistible as the advance of the in-coming tide, is perhaps better estimated by comparing present results with those of fifty, or even five-and twenty years ago, than by reviewing the events of any given year. More especially is this the case, if we turn to the grand science of astronomy. There is, to my mind, no other

science so fascinating, so engrossing as astronomy ; none in which the sober statement of facts appeals so strongly to the imagination, and which excites alike our curiosity and awe, our wonder and our reverence. No other science enables us to realise so vividly the almost boundless powers of the human mind, while, at the same time it impresses upon us our own littleness as compared with the illimitable vastness of the universe and its myriad worlds.

At the meeting of the British Association last year, Professor Higgins, in his brilliant inaugural address, enlarged upon the marvels of astronomy as revealed by the spectroscope, one of the grandest inventions of this century. After alluding to the birth of the spectroscope at Heidelberg in 1859, Professor Higgins pointed out some of the most brilliantresults accruing from its use, by no means the least being the part it has played in astronomical photography. Indeed, since the appearance of Virchoff's great work on the solar spectrum and the interpretation of its lines, a rich harvest of results has been gathered by scientific workers. What the telescope was to Galileo the spectroscope is to the modern astronomer; the telescope brought near what was remote, but the spectroscope, which takes no note of distance, reveals movements amongthe heavenly bodies which the telescope could not detect ; these are,in their turn, seized by the gelatine dry plate of the camera, and permanently recorded. The value of these astronomical photographs can hardly be over-estimated ; they are immeasurably superior to the best hand drawings for this reason, that they are absolutely free from any individual bias and have no "theory" to maintain. Valuable as are the drawings of such men as the Herschells, Beer, Mädler and others, they are still marred to some extent by the partiality of the respective draughtsmen to some pet theory. Since the introduction of the gelatine dry plate, a great impetus has been given to this branch of photography ; what the photographic plate sees it records, nay more, it observes and discloses what the more finite vision of the astronomer fails to detect. The eye fails to perceive any object which is too faintly luminous to be seen at the first and keenest moment of vision, whereas the light which falls on the photographic plate is continually being taken in and stored up, so that each hour it receives three thousand six hundred times as much light as in the first second.

Perhaps the most memorable event of the past year has been the the commencement of the great photographic chart and catalogue of the Heavens, the idea of which was first mooted at the Paris International Conference in 1887. Eighteen observatories have been engaged for the last three years in the preliminary arrangements and experiments, and the time has been found none too long for preparing the special instruments for this great work, which

will include stars of the fourteenth magnitude. Many years must of course elapse before the completion of the chart. When photography was as yet in its infancy, a brilliant future, in connection with astronomy, was prophesied for it by Arago, who wrote with enthusiasm of a photographic picture he had seen of the moon. Since then, lunar photography has developed to such an extent, that, according to an American geographer "there are many parts of the new world less accurately chartered than the "seas" valleys, and mountains of the pale inconstant planet." Photography has played a no less important part in revealing to us the nature of the sun himself, the corona and the fiery streamers; indeed, it is now some years since Sir John Herschell wrote that, "the orb of day has been compelled to write its own history."

An important fact disclosed by the spectroscope is, that "terrestrial matter is not peculiar to the solar system above, but is common to all the stars visible to us." Take, for instance, the star Capella, whose spectrum is almost identical with that of the sun, and whose constitution and temperature we have therefore every reason to suppose is also the same. Professor Rowland has shown that the lines of at least thirty-six terrestrial elements are present in the solar spectrum; as to fifteen other elements, there is very little evidence that they are absent from the sun, but ten others of which oxygen is one, have not yet been compared with the sun's spectrum. Hence we may conclude that if the earth were heated to the temperature of the sun, its spectrum would be very similar. Professor Rowland is now endeavouring to discover by means of these lines in the solar spectrum, which are as yet unaccounted for, new terrestrial elements which may possibly lurk in rare earths and minerals, his method being to compare their spectra with that of the sun. It is a curious fact that our knowledge of the spectrum of hydrogen came to us from the spectra of the stars, and, in the same way, chemistry is even now seeking for new elements in our earth by means of the solar spectrum.

I may here mention in passing that, Professor Higgins entirely confirms Professor Schuster's theory of the origin of the sun's corona; namely, that it consists of matter, flowing from the sun under the influence of some force, probably electricity. Some particles of the corona may possibly return to the sun, but the greater portion, forming the long "fiery streamers," or rays of light do not appear to return; they may, not improbably furnish the material for the Zodiacal Light, of which no other explanation has as yet been offered.

The spectra of the stars, although greatly diversified, may yet, to a certain extent, be classified in groups, the sun's place being apparently in about the middle of the series. Astronomers differ

in opinion as to the direction in the series in which evolution is proceeding—that is to say, whether the red or orange coloured stars are younger, and become white in old age, or whether the white stars are in the earlier stage, and pass, in the course of ages, into coloured stars. Professor Higgins himself inclines to the latter theory, and to the classification of stars suggested by Vogel in 1814, in which the white stars (by far the most numerous) represent the younger and longest stage of stellar life, and the orange and red stars, the period of decline and old age. According to some authorities, the sun himself is of about middle age, but it must always be remembered that we do not see him as he really is, his colour being, to our view, materially modified by the intervention of the earth's atmosphere. Some experts contend that a star passes successively from the orange and red to the white stage, and then returns by slow degrees to the red and orange. Another theory suggests that the divergence in colour of the stars does not mark any stage of evolution in their existence, but is due to a difference in their original constitution.

Although the work of interpreting the nature of the stars or nebulæ is comparatively easy so long as their spectra agree with the solar spectrum, it becomes a task of great difficulty when their spectra differ widely from that of the sun, which, as I have already shewn, contains so large a number of terrestrial elements. It must also be borne in mind that the lines or waves which the spectroscope reveals were set in motion many hundreds, or perhaps thousands, of years ago, and the suns whence they proceed may now be dark burnt-out orbs. In the case then of those stars whose spectra differ from that of the sun, there remain but the tests of the laboratory to determine their nature, density, and temperature.

A spectrum of a remarkable nature is presented by the Aurora Borealis, and although we have reason to believe that certain gases are present in it, no similar spectrum has yet been obtained from them by artificial means. It has recently been suggested that the Aurora was produced by the dust of meteors and falling stars, which contained traces of manganese, lead, barium, thallium, iron, and other substances, Exhaustive experiments on this point have been made by Dewar and Liveing with the minute dust thrown off from the surfaces of electrodes of various metals, carried forward under the tube of observation by a rapid current of air or gas. It was then shown that metallic dust does not become luminous in an electric discharge with the characteristic spectrum of the Aurora.

It is now, I believe, generally accepted that the Aurora is a manifestation of the earth's magnetism, and that there is some connection between the display of the northern lights and the maximum period of sun spots. Indeed if the spots or maculæ are

justly attributed to some disturbance on the sun's surface, the influence of which reaches this earth, we may reasonably refer the latter to electricity. There seems little doubt that the recent display of the Aurora had some connection with the remarkable sun spots then visible. These spots when accurately measured, were found to be of the immense size of a hundred thousand miles in length, and sixty thousand miles in breadth, while the whole group extends over a hundred and fifty thousand miles. They were first observed on the 5th of February last, and reached the sun's central meridian on the 13th, on which and the following day a most unusual magnetic disturbance was recorded by the instruments at Greenwich the shadow of the magnetic needle on the sensitised paper being deflected some three or four inches to either side many times during those days. At Potsdam, where the recording instruments are of an exceptionally delicate nature, the magnetic disturbance caused the needle to move with the unprecedented speed of two degrees in two minutes, while another magnetic scale registered as much as three degrees, the recording power of this instrument not being able to go beyond this. These proofs of magnetic disturbance occurred on the 13th and 14th of February, and it was on the intervening night that the magnificent display of the Aurora took place, both on this continent and in America. There are several cases on record in which the maximum period of sun spots has been coincident with similar terrestrial magnetic disturbances. On the other hand these disturbances have occurred when no spots have been visible to us, but it is possible that sun spots may have existed on the side farthest from us.

Professor Higgins alluded in his address to the interesting researches of Professors Schiaparelli and H. A. Newton as to the connection between comets and periodic meteor swarms, and also (by means of the spectroscope) as to the identity of cometary and meteoric matter. At the same time, Professor Higgins inclines on think that the head or nucleus of the comet is due rather to disruptive electric discharges produced by processes of evaporation due to intense solar heat than to clashing of separate meteoric stones, which was the theory of Norman Lockyer.

One of the most interesting points which the spectroscope has established is that of the attenuated nature of the nebulæ. It was originally supposed that the nebulæ were mysterious masses of stars, too remote from this earth for the telescope to show them even as separate bodies, and consequently of no value as throwing any light on the great problem of the universe. This idea slowly gave place to the theory that they were not stars at all, but portions of the "fiery mist" or "shining fluid," out of which the heavens and the earth were originally gradually evolved. I need not tell

you that this theory was developed by Kant and Laplace into the so-called nebular hypothesis. This hypothesis assumes that the entire space now occupied by the solar system was originally filled with a vapourous mass, out of which were evolved the planets, satellites, and the sun himself, the condensation of this nebulous matter giving rise to energy, sufficient to generate both light and heat. So great indeed is the heat induced by this process of shrinkage that, according to Helmholtz, the sun's present temperature would be maintained by the contraction of two hundred and twenty feet of his diameter per annum. Whether the sun is growing hotter or colder, or only maintaining his temperature is not certainly known. The nebular hypothesis has, however, been questioned by many scientists, who favour the theory of evolution from meteorites, which was first propounded by Faye, and which suggests a totally different succession of events, in which the outer planets were formed last. The meteoric hypothesis, as it is called, has found a warm supporter in Mr. Norman Lockyer, who also, like the champions of the nebular hypothesis, bases his views on spectroscopic evidence, which, he maintains shows that comets, meteors, nebulæ, and stars have an identical constitution. The nebulæ he considers to be meteor swarms which not yet been drawn into the solar system. As the individual meteorites are drawn together by the force of gravity, the nebula grows more compact, until from the heat evolved by the clashing of these tiny spheres their substance is so volatilised that the nebulæ is transformed into a glowing star, like Sirius, which is far hotter than the sun himself. As volatilisation ceases, the star cools, gradually grows less luminous, and eventually a dark star is formed. Thus the universe and its countless worlds are accounted for by this ingenious theory to which nevertheless there are many cogent objections. In the first place, although the number of meteors or falling stars is legion, we can hardly imagine it to have been great enough to form the myriad worlds around us. In the second place, meteors being complex bodies, we are no nearer the origin of matter, for no theory has been broached to account for the birth of the primordial meteorite. Thirdly, and I think this is the most valid objection, the spectrum of the bright line nebulæ is, according to Professor Higgins, by no means the same as would be produced by collision of meteorites such as those which have been analysed in the laboratory. The meteoric hypothesis therefore is fast losing favour with the scientific world, and the nebular hypothesis, which for a time was called in question, has been restored to its old place, as offering the best solution of the evolution of the universe,

Mr. Roberts' photograph of the great nebula in Andromeda has been of great value in throwing light on the subject of nebular evolution

—the rings or spiral streams disclosed by the photograph suggesting precisely such a succession of events, as the nebular hypothesis requires. The luminosity or "fiery mist" of the nebulæ is, so Helmholtz considers, accounted for by their contraction or shrinkage the energy exerted by the natural gravitation of matter being amply sufficient to generate the high temperature of the stars, and even the sun himself.

It is a curious fact that while so many suns have grown dim from age, and their light has gradually faded away, other nebulæ are still in their youth, not having yet passed into the star or sun like stage of their existence. Is it possible that they have originated from the collision of dark suns, which have thus produced a newer and later generation of heavenly bodies? During the comparatively short period of astronomical observations, no such collision has been recorded, but it appears the only possible solution of the temporary rejuvenescence of the Heavens which we have every reason to believe is going on. For although the number of dark stars is continually increasing, the stars in the early or middle stage of evolution are by far the more numerous, and some indeed are hardly advanced beyond the nebular stage. Such at least is the opinion of Professor Higgins, who may fairly be considered our highest authority on all matters connected with spectrum analysis.

One of the most practical results obtained by means of the spectroscope is the power of determining the spproach or recession of a star in the line of sight; its velocity also may thus be accurately measured, independently of its distance from us. The scientific value of this novel method of calculation can hardly be over-estimated; by no other means has it been possible even to determine whether the so-called fixed stars were moving or stationary, still less could we measure their rate of advance or retreat; they appeared indeed to us to be standing still. So great is the distance of the stars that no clue to the problem is afforded by the waxing or waning of their brilliance; it is calculated that if the nearest star were approaching us at the rate of one hundred miles per second, its brightness would only be increased one fortieth part, supposing the same rate of progress were maintained for one century! Now, however, thanks to the spectroscope, all this is changed, and the astronomer can, by its aid, determine whether the star is approaching or receding, and can measure accurately its rate of motion, and this moreover independently of its distance, for the rules of measurement apply equally to the nearest planet or the most distant star. This system of measurement was suggested by a well known theory in another branch of science, namely acoustics. I allude to Doppler's famous discovery in 1841, that a sound becomes flatter or sharper as it recedes from, or approaches

us. This principle suggested a new method as a reliable test of the approach or recession of a star and of its velocity, and has been applied as the basis of the new system already alluded to. By measurement of the small shift of the lines in the stars spectrum from their true position as compared with the position of the lines in the spectra of corresponding terrestrial substance, the speed of the star's motion can be accurately ascertained.

Brilliant results have accrued from the application of this principle in conjunction with steller photography. Mr. Keller, of the Lick Observatory, has applied this method to the star Arcturus, the greatest discrepancy between his calculations being only three tenths of a mile per second in the course of the three nights. At the same time five photographic determinations of Arcturus were made at the Potsdam Observatory, and the means of these five determinations agreed with Mr. Keller's observations at Lick to within one-tenth of a mile—a substantial proof of the marvellous accuracy of this new system of measurement.

Mr. Keller has also applied this novel method in his observations of the nebulæ, and found that, like the stars, they possess considerable motion through space, the speed varying from two to twenty-seven miles per second, with the exception of one, which attained the velocity of forty miles per second. He found that the nebula in Orion was receding at the rate of ten miles per second. This spectroscopic method of observing the motion of the heavenly bodies has also been most successfully applied in detecting binary stars, but time will not permit of my entering into further details this evening of this engrossing subject. When we consider the brilliant results achieved by means of the spectroscope in the course of the last thirty years, a boundless vista opens before us, in which new and hitherto undreamt of discoveries await us—a way, indeed, has been opened into the unknown which surpasses the fondest hopes of the enthusiast. To quote Dr. Higgins's own words, "to analyse the chemical nature of a far distant body by means of its light alone, to be able to reason about its present state in relation to the past and future, to measure within an English mile or less per second the otherwise invisible motion which it may have towards or from us; to do yet more than this, so as to make that which is apparent darkness become light, and from vibrations which our organs of sight are powerless to perceive to evolve a revelation in which we see mirrored some of the stages through which the stars may pass in their slow evolutional process—these achievements are surely such that their record, however poor the form of words, is worthy to be regarded as the scientific epic of this century."

After the usual vote of thanks the Secretary read the Rules

proposed for adoption by the Committee. (These as amended and adopted will be found at the end of the proceedings).

Dr. Ross suggested the separation of the offices of Secretary and Treasurer, and this was agreed to. Mr. Walton suggested holding the meetings all the year round, as the Summer months gave greater opportunities for collecting and exhibiting specimens. The question of holding two meetings monthly was discussed, and the arrangement finally adopted.

Dr. Ross proposed an additional rule authorising the Committee to expend money at their discretion, out of the funds, in the purchase of good reference books, and for the purpose of defraying expenses connected with the lantern lectures.

Seconded by Dr. Tyson, and carried.

Proposed by Mr. Blanford, seconded by Mr. Knight that the Rules as amended be adopted.—Carried.

On proceeding to the election of officers for 1892 :—

Dr. Fitzgerald expressed his wish to retire from the office of President. He spoke of his long connection with the Society, and the strong interest he had felt in it since he assisted at its foundation over 21 years ago. But that now various circumstances combined to make the strain on his time and energy rather too much for him, and he would be glad to resign the office into younger and more energetic hands. He would like to propose Mr. Blanford for the office.

Mr. Blanford in reply referred to the long and able services of Dr. FitzGerald, and expressed the great regret felt by all the members at his resignation. But he felt that he could not with satisfaction to himself, carry out the necessary and occasionally arduous duties appertaining to the office of President, and therefore with grateful recognition of the honour offered him he must ask to be excused.

It was finally agreed to postpone the election of President till the next meeting.

Mr. Blanford proposed and Dr. Tyson seconded—That in recognition of the services of Dr. FitzGerald he be asked to accept on his retirement the title of Honorary President.—Carried unanimously.

Dr. FitzGerald in reply thanked the members, and said he should appreciate the compliment highly. Being obliged to leave early, he gave up the chair to Mr. Blanford.

The other officers were then elected, also three new members (see end of the proceedings).

March 15th, 1892.

The night was very stormy, but about 20 members were present. Eight microscopes were on the table and numbers of living objects, chiefly marine, were shown. Mr. A. P. Harris also showed some interesting experiments with the colour top.

April 5th, 1892.

A large number of members and friends were present, Mr. Walton, V.P. in the chair.

Mr. R, Kerr exhibited and described a number of lantern slides illustrating some recent results in photo-micrography. Great interest was shown in the lecture and a warm vote of thanks was accorded. In this Mr. Kerr asked that Mr. Hambridge might share, as it was owing to his patient and persevering labours that many of the slides had been obtained. That of a group of *Vorticellæ*, taken from life, was specially admired.

April 19th, 1892.

Thirty members were present. No paper was read but many microscopical slides and objects were shown :—*Melicerta ringens* by Mr. Kerr; cirrhi of barnacles by Mr. E. Peden; *Vorticella*, *Spirogyra*, &c., by Mr. H. A. Ullyett, and some beautifully mounted fragments of seaweed by Mr. Taylor.

The Secretary showed and described a series of specimens illustrating the life history of the Puss Moth, *Dicranura vinula*.

Mr. S. Hills was elected a member.

Tuesday, May 3rd.

Dr. Fitzgerald occupied the chair during the first part of the evening, when, having to leave early, Mr. Walton took his place.

A lecture was given by Dr. Ross, entitled, "Some Methods of Scientific Research." After describing the general structure of the microscope, the action of light in its passage through lenses, and the methods adopted to smooth away various practical difficulties, a number of lantern slides were shown in illustration. Diatoms and other objects, as seen under object glasses of various powers, so as to bring the minute markings move, and more clearly into view,

were exhibited. Several excellent photographs from life, prepared by Mr Hambridge were warmly applauded; among them were *Melicerta ringens*, and a group of *Vorticellæ*. The earlier part of the lecture was also illustrated by some good diagrams. About 100 members and friends were present.

MAY 17th.

Present, about 30 members. There was a good show of microscopical objects by Mr. Peden and others; among them being a very young *Echinus*, Gall-flies, &c. Miss Rutt exhibited fresh specimens of *Ophrys Aranifera*. The secretary showed a case illustrating the life history of the Drinker Moth (*O. potatoria*) Several new books of reference were on the table.

JULY 23rd.

Mr. Walton kindly conducted a Botanical Ramble in the Lower Sandgate Road, at which fifteen members attended.

SATURDAY, SEPT. 24th.

Another Botanical Ramble in the Warren.

TUESDAY, OCT. 18th.

Exhibition of specimens. Very poor attendance.

TUESDAY, NOV. 1st.

The room was well filled; the chair was occupied by Dr. T. Eastes. The Secretary read the the following paper, (Part I) on

THE GREAT AGE OF ICE.

Greenlard is not a pleasant place to live in; that is my impression, after reading various accounts of it. Nor should I recommend it to tourists, at least not for the present. After Nor-

way has been done as thoroughly as Switzerland has, one cannot say where the hard working holiday-makers of England may not go for their summer vacation, tempted by some future enterprising Cook or Gaze. I admit that even Greenland may have glorious sights in spite of the general monotony of its scenery; there are few places on this grand old earth of ours altogether devoid of attraction. Dr. Nansen, in describing his journey across the inland plateau, says: "We saw only three things—that was snow, sun, and ourselves. One day was quite like another. But still, even this part of the earth has its beauties, and I shall never forget the glorious sunsets, and the nights on the snow and ice fields of Greenland, when the ever changing northern lights were scintillating perhaps brighter than anywhere else." Grand, no doubt, but they can be seen elsewhere, and whether it was worth spending six weeks among the floating ice looking out for a landing place, and then after getting ashore 250 miles south of where they had intended to land, travelling for two months in an unwashed condition painfully over the snow, must be left to the individual judgment. Yet we must bear in mind it was done, not for a holiday, but in the interests of science.

A wild waste desolation of ice and snow, a bare fringe of habitable land on the slightly sheltered west coast: all else—mountains, valleys and table lands levelled up by a huge cap or sheet of ice to a height of over 5,000 feet. Destitute alike of animal and plant life, with coast cliffs of ice hundreds of feet high, from which now and again break off huge projections which are hurried by the sea currents away to the south, to the bewilderment and danger of the navigator across the North Atlantic. Such is the picture which has been drawn for us of this bleak, northern, silent land.

Can you transfer this picture to England? Can you imagine our fertile plains, our "valleys standing so thick with corn that they laugh and sing," reduced to the condition of Greenland? All our hills submerged under a field of snow and ice, a death-like stillness overshadowing it all? It seems an impossibility, yet that is just what I ask you to do this evening, and to believe that not so very long ago (as the geologist reckons time), it was a veritable fact—a fact which is verifiable at the present moment. I am quite aware that it is disputed by some persons. Just as, a few years ago, a book was written to prove the earth was not a globe, but a flat circular plain; just as we have read that the Gulf Stream does not come across the Atlantic to our shores; just as some one lately has attempted to prove that sap goes down a tree, but not up, as the benighted botanists teach us; so a book is promised us shortly, bearing the title of "The Glacial Nightmare," showing that geologists are as benighted as the botanists and the astronomers.

But to-night I am going on the old lines ; the fact of an age of ice is, I say, verifiable. Our islands were then a desolation. With the exception of a few Arctic plants, and fewer Arctic animals, life, which had just previously been so abundant and so luxuriant here, had well nigh disappeared. From Snowdon in Wales, from the summits of the Highlands in Scotland, and from the Lake Mountains, glaciers rivalling those of the Swiss Alps radiated through the valleys in all directions. A great icefield moved away from the Scottish Highlands to the S.E., " across the broad plains of Perthshire, filling them up to the depth of at least 2,000 feet, and passing across the range of the Ochil Hills, which, at a distance of 12 miles, runs parallel with the Highlands, and reaches a height of 2,352 feet. Many mountains in the Highlands are glaciated up to the height of 3,000 feet and more, while lakes at their feet, 600 feet deep, have been well ice-worn." The various forms of northern life retreated southwards from the cold, so that we find remains of reindeer in Switzerland and the south of France; the musk sheep and the Arctic fox beyond the Pyrenees. Now and then (I mean at intervals of some thousands of years) a milder climate prevailed, and these animals returned, and among them we also find that the hairy mammoth, rhinoceros, glutton, and lemming peopled the lower grounds, until Arctic conditions once more prevailed. At times the land sank until it was invaded by vast icefields 1,500 or 2,000 feet thick, which had travelled from Norway across the shallow North Sea, passed over Great Britain loaded with debris from their native country, and uniting with the smaller British ice-streams, pushed onward, and at last formed cliffs out in the North Atlantic, some 200 or 300 miles west of Ireland and the Hebrides, whence they sent westward and southward enormous icebergs, as Greenland does now.

So improbable, nay impossible, some one will say. How could these things be ? What proofs have we ? When did it all take place ? Above all, What brought it about ? Let us see what answers can be given to these questions.

The discovery of the great fact of the former existence of an ice age prevailing over all the northern parts of the world, lasting probably some 200,000 years, and terminating about 80,000 years ago, is undoubtedly one of the grandest additions to our knowledge out of the many which the nineteenth century has seen. We have traced back Chaldean civilisation for 6,000 years ; Egyptian civilisation almost as far. We can write the history of the Hittites, whose great empire had actually passed out of the memory of man more completely than the discovery of America by the Norsemen had been forgotten by Europe ; but what is all this and much more to the discovery of the great Ice Age ? And it is wholly due to the

geologists, to the men of the hammer, who have been described as collectors of petrified shells and bones. Geology, I know, is not a very popular study, and thereby men miss a source of very great pleasure. Let me just say in passing that though so generally looked upon as dry and uninteresting, it is nevertheless a science more replete with wonderment, more abounding in mysterious puzzles and problems, fuller of fairy tales, giant deeds, and marvellous transformations, than any other subject known to the student of nature. And yet so few take it up. To me I confess it has long been a marvel that here in Folkestone, a district so rich in geological material, that men and women come yearly from all parts to enrich their geological knowledge, the local students could be numbered more than once on the fingers of one hand. Our museum will show you that we are frequently coming across the skeletons of mammoth, rhinoceros, hippopotamus, and other creatures, which must have died on the spot where we find them possibly 50,000 or 60,000 years ago. Yet though we have five or six times started winter classes in geology, on only one occasion did the number of students amount to six. This is a digression. Now to our task—How was this ice age discovered ?

One great lesson learned by the geologist, and indeed by every naturalist, is the prevalence of orderly arrangement in nature—the reign of law. The very materials composing the crust of the earth, as far down as we can possibly obtain any knowledge of them whatever, instead of being (as they seem to be) scattered at random, are arranged each one in a certain position, relative to the rest, all according to one definite plan. There are two great divisions of these rocks, viz. : (*a*) Those formed by the agency of heat, *e.g.*, lava, basalt, granite, &c., known as Igneous rocks; (*b*) those which, like limestones and sandstones, were formed in water (these are called Aqueous rocks). Leaving the former out of sight for our present purpose, we find that the rocks formed in water are more or less perfectly stratified, *i.e.*, arranged in layers one above the other, as we may see in the Lower Road. Our diagram illustrates this. Here is chalk, oolite, carboniferous, old red sandstone, &c. No one of these, in whatever part of the world it may be found, ever occurs out of its proper place. Nowhere can you find oolite or lias above the chalk ; no greensand or London clay ever occurs below the coal rocks, &c. Hence we can classify them all according to their relative ages, those at the bottom being of course the oldest. Moreover, each particular set of beds or strata contains within it the plants and animals which flourished in that neighbourhood while those beds were being formed ; and the set of remains differs in each group of strata, so that it is possible to extract the history of the earth from these rocks and in many

instances to trace the development of one set of animals from the preceding set.

Now this regularity prevails with scarcely any break through the whole series of rocks from the Archæan or oldest known beds to those called Tertiary. In all cases we can tell the relative age, the mode of formation and deposition, and the characters of the various kinds of life then prevalent. Then suddenly this regularity seems to end, as we come upon a number of scattered formations to which the regular laws apparently do not apply, and for a long time the geologists were at a loss to account for this. We rarely find any animal or plant remains in these deposits; they are not arranged in layers or strata; they seem scattered promiscuously in various localities, and they repose upon rocks of all ages. All that we can say of them at first sight is, that they are more recent than all the rest. At first their apparently confused and disorderly arrangement (if indeed such a term is applicable at all), was taken as proof and consequence of a confused and disorderly period in the earth's history. It was taken for granted that they represented a "great gap separating the present from the past. Some mighty convulsion of nature was thought to have marked the close of the geological ages, and to have immediately preceded the advent of man, and the introduction of the plants and animals with which he is associated." But, says James Geikie, "the study of these deposits has unfolded a deeply interesting and almost romantic history. We are introduced to scenes that are in strangest contrast to what now meets the eye in these latitudes; geological and physical changes of the most stupendous character pass before us; we see our islands and northern Europe at one time enveloped in snow and ice, at another time well wooded and inhabited by rude tribes of men and savage animals; now the British islands are united to the continent,—again, the sea prevails, and a large part of Britain is overwhelmed beneath the waters of the ocean, across which ere long float rafts and bergs of ice. To these succeed vast confluent glaciers which overflow a large portion of the British area, and usurp the bed of the sea. Yet again, we behold the great icefields vanish away and Britain once more becoming continental and re-peopled. Finally, we follow the working of those physical influences, by which at last the present order of things is brought about." In fact, we may say that what seemed a puzzle at first, has now become a key to at least one chapter in ancient history.

Let us see then, what are the characters of these deposits from which such a romantic history has been extracted? There are three:—Their apparently disorderly distribution, their varied composition, the stones and blocks of all sizes contained in them

and the curious markings found upon them. Sufficient reference has already been made to the first; the deposits occur in any or every district, and they rest "unconformably" as geologists say, upon everything below; they fill up hollows, they lie at the foot of the hills, they are piled up at the mouth of valleys, or spread widely over the plains. As to their composition, sometimes they are of "sharp gravelly sand," at others "expanses of pebbly shingle, and more generally perhaps, of variously coloured clays." In the central counties of England we find "sheets of clay embedded in an open gravely drift, composed of fragments of all the older rocks up to the chalk, masses of which, thousand of tons in weight are embedded in it. In other districts, as the middle counties of Scotland, large areas are covered with a thick, dark, tenacious clay, locally known by the name of "Till," and enclosing rounded and waterworn boulders as well as angular fragments of all the older and harder rocks—granite, gneiss, greenstone, basalt, limestone. and the more compact sandstones. Let me call your attention especially to the presence of such miscellaneous collections in one locality. One is never surprised at the occurrence of blocks of stone of any size, or in any number, provided they are natives, *i.e.*, so long as they belong to the district in which they are found. We naturally expect to see in our own neighbourhood blocks of the sandstone of which the cliffs and inland slopes are composed. Nor do the people of Cornwall feel astonished at the masses of granite scattered on their hills or embedded in the ground. But suppose that such blocks of Cornish granite lay strewn around Folkestone, and the Folkestone sandstone rocks were on the Cornish heights, then they would be foreigners, not natives, and their presence would require explanation, just as much as would the presence of a colony of New Zealanders in some recess of the Highlands. Most striking among such blocks are solitary specimens found in Cumberland, Scotland, and Switzerland—composed of stone, different to any kind known for miles around, lying like solitary strangers in a strange land, or a stranded vessel on an unknown shore. "Erratics" they are called—wanderers. At Prevolta, in the Alps, there rests upon hills of limestone, along with thousands of others, the erratic shown on the screen, a block 50ft. long, 40ft. broad, and 25ft. high, with all its edges and angles perfect; it is composed of granite, and weighs about 5,600 tons. How came it there? Note again on the next slide the "perched blocks," as they are called, seen by every tourist in the Pass of Llanberis.

Almost everywhere on the Jura Mountains, Sir C. Lyell tells us, lie these granite, gneiss, and other crystalline blocks, which undoubtedly came across one of the widest and deepest valleys in the world, from the Alps, which are fifty miles distant. How did they

travel across, and how did they get up the hill? Sometimes these erratics are curiously marked with parallel scratches, sometimes with two or three sets of them crossing each other. Similar markings can also be seen on the rocks in situ on each side of the valley and in the bed of the valley. Frequently the faces of these rocks are polished quite smooth, as if an enormous weight had been slowly moving for them for long ages. You may see all these as you wander about in the Alps or in the Scottish Highlands; the valleys radiating from Snowdon abound with deeply scored masses, the marks as a rule all tending down the valleys. What are these marks? How were they made? What were the graving tools?

As men travelled about more and studied more deeply what they saw, another phenomenon was noticed, viz., the occurrence of numerous lakes, where the marks and signs already noticed were found—long narrow lakes lying in the valleys, bordered by the scratched rocks, and at the lower ends of these lakes huge mounds of debris, composed of materials found in the valleys themselves, and containing pebbles and blocks of all sizes, some smooth and rounded, others with the hieroglyphic scratches. The presence of these lakes and mounds must then be taken into account in any explanation that may be given. We may instance such localities as the Highlands of Scotland, the Lake District of England, and especially the north of Europe and of North America.

I have put before you the problem,—What have we to say in explanation of it?

It is the general practice now among all students of nature, geologists especially, to try to explain all phenomena by the action of known causes. In the early part of the century it was not so, and the phenomena I have so briefly described, so extensive in their results and betokening apparently such huge and unfamiliar agency, seemed above all others incapable of explanation in such fashion—all spoke of irregularity and confusion. And so men fell back on hypotheses, on invented, not discovered, explanations, as man is so prone to do. There is no harm in the thing itself, so long as you have sufficient ground to go upon, but to invent out of one's inner consciousness a wild baseless explanation is not scientific, though it may sometimes be easy—easier than searching for facts. A friend of mine, who is always trying to explain the unexplainable, whenever he is non-plussed, says it must be electricity, of which agent he has invented several varieties unknown to the scientific world, just as in mediæval times all mysteries were referred to the agency of the great magician, Michael Scott,

> A wizard of such dreaded fame,
> That when, in Salamanca's cave,
> Him listed his magic wand to wave,
> The bells would ring in Notre Dame?

From such tendency came the hypothesis of huge floods coming somehow, and from somewhere, sweeping across continents with irresistible power, carrying before them all loose materials and even great rock masses. The general term "diluvium" was applied to the deposits, while references more or less vague were made to the Deluge of Noah. When our early geologists were pressed to account for these torrential floods, they spoke of the sudden uprising of mountain chains, like the Alps, Himalayas, and Andes. Certainly if we can but hypothetically allow a sudden emergence from the depth of the sea of a mountain ridge 500 to 1,000 miles long, and 15,000ft. or 20,000ft. high, we shall be at no loss to account for destructive currents of water over the lands. But such catastrophes and cataclysms have long ago been rejected in geology. You may find a somewhat sensational, very circumstantial and highly interesting account of these floods in Figuier's "World before the Deluge." He tells us that "There is very distinct evidence of two successive deluges in the northen hemisphere. He gives us a practical illustration of one, caused by the upheaval of the Norwegian mountains; it covered all the plains and valleys of Northern Europe with a mantle of shifting soil. It carried with it "enormous masses of ice; and the shock produced by the collision of these several solid blocks of frozen water would only contribute to increase the extent and intensity of the ravages occasioned by this violent cataclysm, which (he says) is represented in Plate xxx." (Shown).

The time will not allow us to enter more at length into the hypothesis of this altogether abnormal flood, the account of which you can easily read for yourselves, together with the proofs of its occurrence. In their calmer moments men began gradually to doubt the soundness of such an explanation. They found these travelled blocks of stone, these erratics, some of them weighing thousands of tons, lying, perhaps, hundreds of miles from their original homes; and they said, "No; no possible floods can account for them." For, in many instances, these huge erratics have been actually carried up hill, and over into the next valley; and though a strong flood of water might possibly assist gravitation in hurling them down a slope, we cannot image such a flood against the power of gravitation carrying them up another one. It was not long before men noticed certain portions of the earth were absolutely free from these irregular phenomena; that they were not to be detected in the countries round the Mediterranean; that they occurred only in the colder regions, becoming more and more numerous as we travel northward and approach the Pole. It was said that no traces of them had been seen in the tropics, but that they re-appeared as we neared the South Pole.

And so it gradually dawned upon the scientific mind that there was some connection between these appearances and cold, more particularly with ice in some form or another. We may wonder in these days how the connection eluded their observation so long; to us it seems self-evident. But travellers abroad were not so numerous then as now; comparatively few had seen either Greenland or Switzerland and still fewer had even in the latter country, seen the glacier and the avalanche at work. Those who had, however, came back and told us that all these irregular phenomena could be seen in Switzerland and other countries, far more distinctly and abundantly than in Great Britain. More than that, they were actually to be seen in process of formation; the agents were visibly at work, the mystery was solved. Among the Alpine hills and valleys were to be seen in abundance the markings on the rocks, the polished stones, erratics of all sizes, numerous lakes and the huge mounds at one end of them called moraines; and they said there could not be the slightest possible doubt about glaciers being the cause of it all.

All the chief points were illustrated by the Lantern and Lime-Light. The second part of the paper was promised for December.

The Lecture was well illustrated by the Lime-light. The usual vote of thanks was passed, and the second part of the Lecture was promised for the December meeting.

Tuesday, November 15th.

A Microscopical evening; but the weather being very boisterous the attendance was small.

Tuesday, December 6th.

This, in accordance with the new rules was the Annual Meeting. Dr. FitzGerald was in the chair. The first business was the reading of the report for 1892, of which the following is a summary:— The title has been changed to that of "The Folkestone Natural History and Microscopical Society," as the two societies have amalgamated, and the meetings are held on the first and third Tuesdays in each month. A new set of rules has been drawn up,

copies of which may be had of the Secretary. The nucleus of a good scientific library for the use of members has been formed, and contains already some valuable works. The number of members is 99, and the balance sheet shows eight pounds in favour of the society. Next came the election of a President, Dr. FitzGerald having resigned at the previous annual meeting and no one having been appointed in his place. He was present in the chair, however that evening, and proposed as his successor Dr. Thomas Eastes, whose name was warmly received and who was unanimously elected. The same Vice-Presidents as before were chosen, and also the committee, to which latter were added the names of Mr. Hambridge, Mr. S. Hills, and Mr. A. H. Ullyett. Mr. Kerr remains Secretary of the microscopical section, and Mr. H. Ullyett, General Secretary. Business matters were succeeded by the second part of Mr. H. Ullyett's lecture on the Ice Age, illustrated by lantern slides. After giving a brief description of ice and ice phenomenas as at present displayed in Greenland, India, and Switzerland, he proceeded to give the generally accepted

CAUSES OF AN ICE AGE.

About the causes of these glacial periods there have been many theories, *e.g.*: (*a*) That the solar system, in its journey as a whole through space, passes through regions of varying temperatures; (*b*) That the hot and cold ages are caused by the changes of position in the earth's axis; (*c*) By varying elevations of the continents and by change of positions of land and sea; (*d*) The astronomical explanation connected with the name of Dr. Croll, and more fully worked out lately by Sir Robert Ball.

It would be impossible for us this evening to enter fully into all these theories and to point out their probability or improbability. I shall therefore confine what little I have to say to the last, the astronomical theory, so extensively held at the present time, although many good authorities are beginning to fall back on some of the others, notably the varying elevation of the land.

To make this theory of Dr. Croll's perfectly clear, it is necessary to enter to a slight extent upon the astronomical relations of the earth. The path described by the earth in its yearly journey round the sun is called its orbit; the path which the sun, in consequence of the earth's movement appears to describe, is called the eliptic. It is important, in connection with our explanation, to bear in mind that the earth's orbit is not a circle, although it does not differ much from that figure. It is actually an ellipse of small eccentricity, by no means the exaggerated ellipse which is often so mis-

leading to young students in the ordinary diagrams. Drawn in its true proportions, the eye could detect no variation from a circle, hence it is useful to *slightly* exaggerate it, so that it can be seen to be elliptical. A circle has one important point within it called its centre; an ellipse has two, each called a focus, and the closer together these two points are, the nearer the approach to a true circle. The orbit thus being an ellipse, and the sun occupying one of the foci, it is evident that the earth's distance from the sun is constantly varying, being in fact never the same for two successive days. The difference between the distances in January and July is considerable; we are nearly three million miles nearer the sun in the first week in January than in the first week in July. At the former time the earth is said to be in perihelion, at the latter in aphelion. In the orbit there are four important positions occupied by the earth—they are the summer and winter solstices in June and December, giving us the longest and shortest days, and the two equinoxes in March and September, at both of which the days and nights are of equal length all over the world. It will be convenient for the purposes of explanation that we confine our attention to the two latter positions which will divide the year simply into summer (including spring) and winter (including autumn). Now notice that the two equinoxes do not divide the orbit into two equal parts; one is shown much longer than the other, and the earth takes a longer time to traverse it, for two reasons—(*a*) Because the distance is longer; (*b*) because the farther the earth is from the sun the more slowly it travels. At the present time it takes seven days longer to travel over the larger arc than the smaller one, and as it happens that our summer in the northern hemisphere occurs while this longer arc is travelled, our summer is seven days longer than our winter, the number of days being respectively 186 and 179—I mean from one equinox to the other. On the opposite side of the globe of course these numbers are reversed. The unequal lengths of summer and winter have a most important bearing on what we have to say presently.

And here I must introduce the factors of the problem lately put forward by Sir R. Ball which go so far to strengthen Dr. Croll's explanation. The total quantity of heat received by the whole earth in the summer and in winter is the same, but taking the northern and southern hemisphere separately, it is not so. Sir Robert Ball proves mathematically that out of the total quantity of heat received by each hemisphere in the year, 63 per cent is received during its summer, and 37 per cent. during its winter. This he says is invariably the case under all possible conditions.

Now since the general climatic conditions of the earth depend chiefly and radically upon the heat derived from the sun, we shall

find that the four positions of the earth referred to already, are evidently important ones. If the shape of the orbit is constant, if the localities of these positions are permanent and taken up at exactly the same time every year,—then the climatic conditions are unchangeable too. One other point however has to be borne in mind, viz., the position of the earth's axis. The axis does not stand upright as we might say, if it did there would be no seasons. At present it is inclined to the plane of the orbit at an angle of about 23½ degrees, and it is the inclination of the north pole in the direction of the sun that brings on our summer, this, as already stated, being the case while the earth is at its greater distance from the sun, and travelling round the larger curve of its orbit. If this position of the axis is invariable, then along with the other conditions mentioned, we shall have a general permanency of climate. But the very title of our subject implies great change of climate, and here we enter upon its explanation. Though there is stability in the Solar System as a whole, there is everlasting change going on among the units that compose it. Rest, there is none in the whole Universe of God. The physicist tells tells us that in every block of the finest steel, each invisible particle or molecule is in constant movement with a rapidity ultra-microscopic and altogether inconceivable, yet no molecule escapes, and the mass of granite and the block of steel preserve their size, shape and weight. So the astronomer also teaches us, that suu and plant and satellite, meteor and asteroid, are in movement of inconceivable swiftness; the sun with all its attendants rushing forward through space, whence and whither no one can tell; each planet meanwhile whirling round the sun, not in the smooth linear orbit we draw in our diagrams, but sometimes outside it, sometimes inside, yet always keeping true to its main direction; rotating on its axis, the axis like itself never preserving exactly the same direction; the orbit of the planet, like an elastic ring expanding and contracting—now elliptical and now nearly circular, but always restrained within certain defined limits; the equinoxes to which we have referred never occurring in the same spot, but they and the perihelion travelling round in opposite ways; thus as it has been eloquently said, "mutation and change are everywhere found; all is in motion, orbits expanding or contracting, their planes rocking up or down, their perihelia and nodes sweeping round the sun in opposite directions, but the limits of all these changes are fixed; these limits can never be passed, and at the end of a vast period, amounting to many millions of years, the entire range of fluctuation will have been accomplished, the entire system, planets, orbits, inclinations and nodes will have regained their original values and places, and the great bell of eternity will have then sounded One."

Change then, we see, in all the circumstances which govern the climate of the earth; therefore change in that too. The phenomena which are most intimately connected with the climatic conditions, and specially with the production of an Ice Age are:—(*a*) The variations in shape of the earth's orbit, and with that the varying relative distances of the sun in summer and winter. (*b*) The precession of the Equinoxes together with changes in the direction of the earth's axis.

The excentricity of the orbit at present is comparatively slight, and is decreasing so that it is becoming more and more circular and will (so we are told), be as near to a circle as possible in the year A.D. 25,780, after which date it will contract again in its minor axis, and become more elliptical. The major axis alters in length to such a very minute extent that it need not be taken into account in connection with our subject. It necessarily follows that an alteration in the ellipse itself produces an alteration in the relative position of the foci, at one of which, as we have seen the sun is placed. Such alteration of the shape of the orbit is produced by the influence of the other planets, chiefly by Venus and Jupiter. Note then that if the ellipticity increases, the two foci are farther apart from each other *i.e.* nearer to the earth's orbit, and consequently the sun will be much nearer to us when we are in perihelion than it is at present and much farther off at the the time of aphelion. Since the intensity of the sun's heat and light received by us are proportional, not to the simple distance, but to the square of the distance, such variation will have a considerable effect on the climate of the earth. The difference in distance in summer and winter is nearly 3,000,000 miles, but it may amount to as much as 14,000,000 and then the differential climatic effect would be greatest of all. If, as at present the summer happened when the earth were in aphelion it would be a much cooler summer than we now enjoy, and the winter would be very much warmer. But if, on the contrary, our winter occurred in aphelion, there would be a much severer winter and a much hotter summer. And, at the same period, the winter would be much longer (it might possibly be 33 days longer than summer), and we should have in the combination the requisite conditions for a glacial period. Under what conditions, we may ask could there be the greatest difference in the lengths of summer and winter? This leads us to consider the second variation, viz., the Precession of the Equinoxes. The Equinoxes, *i.e.*, the times of equal day and night all over the world, occur twenty minutes earlier every year, and hence they travel round the whole orbit, and occur successively in every part of it. On the slide we see them approximately in their present position. By and bye the spring Equinox will be in aphelion, the autumnal in perihelion; the orbit will then be equally divided, and summer

and winter will be the same length. But consider their positions. When the line joining them is at right angles to the major axis; we have then the extreme case, the greatest inequality between the portions of the orbit, the greatest difference between summer and winter, which as I said, may (but not necessarily always be 33 days. There might then be a summer of 199 and a winter of 166 or a winter of 199, and a summer of 166. Take the latter case, and you have again the conditions necessary for an Ice Age.

Now, how does the intensifying condition put forth by Sir R. Ball affect this?—viz., the unequal distribution of yearly sun heat in each hemisphere, 63 degrees in summer, and 37 degrees in winter, which never varies under any conditions. A fair distribution (if we may say so), would be that the long winter should get the 63 and the short summer the 37. But this never happens. In the short summer of 166 days we should receive the usual 63 degrees, and the 37 degrees would be spread over the long winter of 199 days. This does happen at recurring periods, and evidently assists in producing an Age of Ice.

You notice that during the period of long cold winters, our summers would be intensely hot. Heat is as necessary as cold to produce a Glacial Age; since heat is the agent by which rain and snow are formed, out of which glaciers are produced; and the long winter would produce ice in such quantities that the short summer would melt a comparatively small portion of it.

To sum up then what has been brought forward: We may expect a Glacial Epoch when these two conditions occur at the same time. *a* When the ellipticity is greatest and the difference in the sun's distance in summer and winter is greatest. *b* When winter occurs in aphelion and is therefore much longer than the summer. Along with these we must place the constant fact of the northern (or southern) hemisphere, receiving the largest amount of heat in the short summer, and the smaller quantity in the long winter.

As regards the date of the last Ice Age, if we accept the Astronomical Explanation, the above conditions were fulfilled during a period of 160,000 years, from 240,000 years ago to about 80,000 years ago. But the ice and its effects would last long after that before they disappeared, or rather before the ice retreated to its present position round the North Pole.

The Lecture was well illustrated by Lantern Slides.

Notes one Lepidoptera at Folkestone in 1892, kindly supplied by Mr. Stuart Hills.

Lepidoptera at Folkestone in 1892.

There seems to have been an abundance of Lepidoptera all over England during the year 1892, and collectors at Folkestone, as usual, were well to the fore in obtaining some of the good things that were about. The most noteworthy event was the occurrence of *Colias Edusa* and its ally *C. hyale*. Although not so plentiful as in 1877, they were to be met with in great numbers. Mr. S. Hills records *C. edusa* as appearing on May 29; specimens were to be found in good condition up to Oct. 6th. Mr. Austen, Colonel Le Grice, Mr. James, and Mr. Hills took fine series both of *C. edusa* and its variety *helice*; also of *C. hyale*. The two greatest rarities captured during the season were *Ophiodes lunaris*, by Mr. Austen, and *Cleontha perspicillaris* (Purple Cloud) by Lieut. Brown, both in May. *Deiopeia Pulchella* also occurred, specimens being obtained in May by Colonel Le Grice, Mr Gordon, Mr. Hills, and one in August by Mr. Austin. In June *Plusia moneta* was taken by one of the pupils at Sir E. Currie's school, and *Albipuncta* by Mr. Austen. A fine specimen of *Sphinx convolvuli* was secured in September by Mr. James. In the same month *Eugonia autumnaria* was taken by Mr. Hills. Of species new to Folkestone, two are recorded by Mr. Austin, viz., *Nola centonalis* in July, and *Ptilophora plumigera* in October.

Mr. Hills also informed me that about the time the swallows were congregating for their departure in October, *C. Edusa* disappeared. He saw several caught by the birds, as he was entomologizing in the Horse-shoe Hollow. *P. gamnna* was eagerly chased and eaten.

Rainfall in Folkestone for 1892—32·72 inches. (Mr. J. W, Stainer)

BALANCE SHEET FOR 1892.

Receipts	£	s.	d.	Expenditure.	£	s.	d.
Balance for 1891	15	7	10	Printing and postage	11	13	8
Subscriptions for 1892	16	10	0	Books for Library	8	10	5
				Hire of Lantern	2	2	0
				Attendance	0	15	0
				Collector's commission	0	16	6
				Balance in hand	8	0	3
	£31	17	10		£31	17	10

LIST OF SOCIETIES,

WITH WHICH "PROCEEDINGS ARE EXCHANGED."

The Scientific Association, Meriden, Conn., U.S.
The Academy of Sciences, New York.
The Academy of Sciences, Philadelphia.
The Elliott Society of Science and Arts, Charlestown.
The Rochester Academy of Science, Rochester, N.Y.
The Imperial German Academy, Halle-on-the-Saale.
The Tunbridge Wells Natural History Society.
The Huddersfield Naturalists' Society.
The East Kent Natural History Society.
The Brighton and Sussex Natural History Society.
The Eastbourne Natural History Society.
The Harrogate Natural and Scientific Society.
The Geological Society, Glasgow.
The Philosophical Society, Glasgow.
The Manchester Microscopical Society.
Société Scientifique du Chili.

Their publications can be seen on application to the Secretary

OFFICERS & RULES OF THE SOCIETY

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C. E. FITZGERALD, M.D.

President:

T. EASTES, M.D.

Vice-Presidents:

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Joint Secretary for the Microscopical Section:

R KERR, F.G.S.

Hon Secretary & Treasurer:

HY. ULLYETT, B.Sc., F.R.G.S.,

Sea View Villa,

Folkestone.

RULES.

1.—That the Society be called "THE FOLKESTONE NATURAL HISTORY AND MICROSCOPICAL SOCIETY," and its objects shall be to work out the Natural History of the locality, to promote the study of all branches of Natural History, and to facilitate mutual assistance between its members in such study.

2.—The affairs of the Society shall be managed and administered by a President, four Vice-Presidents, an Honorary Secretary, an Honorary Treasurer, a joint Secretary for the Microscopical section and a Committee of six Members. Three shall form a quorum.

3.—The Officers and Committee shall be elected annually at a General Meeting, to be held as provided in Rule 8. A list of nominees shall be prepared by the Committee, and submitted to such Annual Meeting, and the election shall then be made by show of hands. Any vacancy which may occur during the interval between two Annual Meetings shall be filled in by the Committee, and reported to the Society at the next meeting.

4.—All persons above sixteen years of age are eligible as members. Anyone desiring to join the Society must be proposed and seconded by two members at any ordinary meeting, and may then be elected by show of hands.

5.—All members shall contribute a Subscription of Five Shillings annually, payable on election, and on each succeeding first of January. Members elected in December shall not be liable for any subscription until the following first of January.

6.—An ordinary Meeting of the Society for the election of Members, for reading and discussing papers and correspondence, and for the exhibition of Microscopical and other specimens, shall be held on the first and third Tuesdays in each month at the Museum at 8.15 p.m.; or at any other time and place duly notified to the members.

7.—Each member may introduce two friends at any ordinary meeting,

8.—An Annual General Meeting of the Society for the election of Officers and Committee, for receiving and considering the statement of accounts and a report of the Committee on the affairs of the Society, for alteration of Rules, and for other business, shall be held in December. Six members shall form a quorum at such meeting.

9.—In the event of its becoming necessary in the interval between two Annual General Meetings to consider any proposed alteration in the Rules, or other matter of special importance, such question may be considered and settled at an ordinary Meeting of the Society, provided that notice thereof has been given to the members.

10.—The Committee may at its discretion make grants of money from its available funds towards paying the expense of illustrating lectures and for the purchase of books on Natural History and Microscopy.

LIST OF BOOKS

Belonging to the Library of the

Folkestone Natural History & Microscopical Society.

Micrographic Dictionary. By J. W. Griffith and A Henfrey. 1883.

Forms of Animal Life. By Prof. G. Rolleston. 1888.

Smithsonian Report—United States National Museum. 1889.

Practical Microscopy. By G. E. Davis. 1889.

Life Histories of North American Birds. By Capt. C. Bendire. 1892.

Manual of Marine Zoology of the British Isles. By P. H. Gosse —2 vols. 1855-6.

History of British Hydroid Zoophytes. By Rev. T. Hincks— 2 vols. 1868.

History of British Sea Anemones and Corals. By P. H. Gosse. 1860.

History of British Starfishes and other Echinodermata. By Prof. E. Forbes. 1841.

History of British Marine Polyzoa. By Rev. T. Hincks—2 vols 1882.

The Year Book of Science for 1892. Published by Cassell and Co. 1893.

The Year Book of Scientific and Learned Societies for 1893. Published by Griffin and Co.

These Books are in the custody of Mr. S. Hills, *at the Public Library, and may be borrowed by Members only on application to him.*

LIST OF MEMBERS.

Austen, Mr.
Bowles, R. L., M.D.
Birch, Mr. H.
Blanford, H. F., F.R.S.
Bosanquet, Rev. C., M.A.
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Wainwright, J., M.D.
Wicks, Mr.

FOLKESTONE

NATURAL HISTORY

AND

MICROSCOPICAL SOCIETY.

FOUNDED APRIL 4TH, 1868.

PROCEEDINGS FOR THE YEAR 1893.

CONTENTS:

Tenth Series.

To which is appended a Revised List of the Plants found in the Neighbourhood, compiled by G. C. WALTON, F.L.S., Vice President of the Society.

FOLKESTONE:
J. English, Printer, Express Works.

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FOLKESTONE
NATURAL ✢ HISTORY ✢ SOCIETY.

PROCEEDINGS

FOR THE YEAR 1893.

Tenth Series.

January 17th, 1893.

The ground was covered with snow, and it was bitterly cold; consequently the attendance was small, only 25 being present. The exhibits were:—

Specimens of Fluoride of Calcium (Derbyshire), in the rough, polished aud crystalline states.

Landscape Marble from Clifton (Rhætic), by the Secretary.

Lantern Slides of various marine Microscopical objects, taken by Mr. Hambridge.

A species of worm (Gordius?) dug up in the garden by Mr. S. Hills.

Microscopical Objects by Messrs. Hills, Gell and Peden.

The President, Dr. Thos. Eastes, said a few words about the special objects of the Society, and then brought before the notice of members two books recently published, viz., "Gordon's British Birds," and "Lubbock's Beauties of Nature," giving a short account of the contents of each. He then called upon Mr. Walton who described some of the shrubs and trees found in Folkestone. The remainder of the evening was spent in the examination of the specimens. Three new members were elected:—Messrs. T. Newman, W. Roberts, B.A., and Mr. Dalgleish.

February 7th.

About 40 were present, the President in the chair. The Secretary was absent through illness.

The President alluded in suitable terms to the loss by death of one of the Vice-Presidents, Mr. H. F. Blanford, and proposed the following resolution:—

"That we as members of the Folkestone Natural History and Microscopical Society, desire to convey to Mrs. Blanford and her family our sense of the great loss they have sustained in the death of Mr. Blanford, and our heartfelt sympathy with them in their bereavement. We also desire to add that we ourselves feel with deep regret that we have lost in him our most learned member and Vice-President, and we would recall the fact that he was President of the Microscopical Society at Folkestone from its foundation until it was amalgamated with the Natural History Society."

This was seconded by the Rev. W. Hall, who spoke of the great interest taken by Mr. Blanford in the Town Museum as well as in the work of this Society. The resolution was carried unanimously, and on the motion of Mr. Walton it was also resolved:—

"That the Secretary be requested to forward to Mrs. Blanford a copy of the above resolution.

The President then read the following paper on

THE BIRDS FREQUENTING OUR TOWN GARDENS.

I will first give a portion of our time to the consideration of a few points about Birds in general, and then proceed to treat of some species in particular. What is a Bird? I suppose less mistakes would be made by the unlearned in deciding what is a bird and what is not than in any other of the great classes of the animal kingdom. I scarcely think that any bird could fail to be recognized as such, and bats are the only other animals that could deceive anybody. *The one great distinguishing character of the class is that the body is clothed with feathers.* Most of them have the power of flight developed in a high degree. They all lay eggs from which they produce their young. Their bill is hard and sheathed in horn; and most of them build nests. But these latter characters are none of them possessed exclusively by birds; but in the existing state of nature the clothing of feathers is their peculiar property, and distinguishes the class. In my last paper on Birds I dwelt rather on the anatomy of a feather, and shewed how beautifully it is adapted to its functions; lightness and strength being its most prominent characteristics. The midrib or stem is divided into tube and shaft. The tube is hollow with a little depression at its root where it has grown from its papilla, and a

little opening on its under surface, where it joins the shaft, by which its cavity communicates with the exterior, the tube is cylindrical but the shaft rather square on section. On each side of the shaft are the barbs, and each barb has another series of divisions on each side called barbules. In the chief feather for flying, every barbule on the further side of the barb has a little hook by which it more securely overlaps the barbules of the next barb so as to increase the resistance to the air and make the feather more rigid Other peculiarities in birds are the air sacs which are developed in different parts of the body and communicate with the lungs, and the air centres in many of the bones which also communicate with the lungs. Then the use of the two fore limbs for flying necessitates many modifications of beak, neck, and claws for seizing and holding. The beak undergoes very remarkable modifications in different birds, which I hope to be able to dwell on, on some future occasion. The neck is usually made of many more vertebræ than in Mammals, and it is extremely flexible, and always long enough for the beak to be able to reach the base of the tail. The claws and toes are most serviceable for holding, climbing, tearing, and fighting according to the needs of the owners.

I will now proceed to consider some of our common birds of the Passerine Order, or Perching Birds. We all know the Thrush, Turdus musicus, and a very welcome visitor of our gardens it is to most of us. Who has not seen and heard it singing its sweet song perched on the same branch of a tree for nearly an hour without moving an inch? I have had a telescope directed at one whilst it was singing about 30 yds. away, and it brought it apparently to within about 6 or 8 feet, so that the bright eye and rapidly moving beak and throat made a very pretty object adding to the beauty of the song. It has what I should call a soft but bright liquid eye which seems to look in all directions at once. The feeding habits of the Thrush are very peculiar. If you are walking in the further part of the Warren you may often pass by a heap of broken snail shells on the top of a little mound with one or two large stones projecting from the ground; these fragments are made by the Thrush. It takes the snail shell in its beak and gives it a vigorous blow against the stone, repeating the action until the shell is so broken that the snail can be extracted. So that as the Butcher Bird has its larder, so the Thrush has its kitchen midden or shell mound. Hear what Macgillivray says of the song of the Thrush in the Hebrides:—" In other places the song of the Thrush may be lively and cheering; here in the ocean-girt solitude, it is gentle and soothing. By its magic influence it smoothes the ruffled surface of the sea of human feelings, as it floats over it at intervals with its varied swells and cadences, like the perfumed wavelets of the

summer wind. Here on the hill-side lay thee down on this grassy bank, beside the block of gneiss that in some convulsion of primeval times has been hurled unbroken from the fissured crag above. On the slope beneath are small winding plots of corn, with intervals of pasture and tufts of the Yellow Iris. The coast is here formed of shelving crags and jutting promontories, there stretches along in a winding beach of white sand, on which the wavelets rush with gentle murmur. Flocks of Mergansers and dusky Cormorants are fishing in the Bay ; the white Gannets are flying in strings towards the ocean ; the Rock Doves glide past on whistling pinions, and the joyous Starlings bound towards their rocky homes. Hark to the cry of the Corn-Crake, softened by distance, now seeming to come from afar, now louder, as if borne toward you by the breeze. It has ceased, but the Cuckoo calls to his mate from the cairn on the hill. Again all is silent. The streaks in the channel show that the tide is ebbing; a thin white vapour is spread over the distant islands ; and beyond them the spirit wings its flight over the broad surface of the ocean, to where the air and the waters blend on the western horizon. But it is recalled by the clear, loud notes of that speckled warbler, that in the softened sunshine pours forth his wild melodies on the gladdened ear. Listen, and think how should you describe the strain so as to impress its characters on the mind of one who never heard it. Perhaps you might say that it consists of a succession of notes, greatly diversified, repeated at short intervals with variations, and protracted for a long time ; that it is loud, clear, and mellow, generally sprightly, but at times tender and melting. You might add that two birds at a distance from each other often respond, the one commencing its song when the other has ceased ; and that sometimes several may be heard at once, filling a whole glen with their warblings. Listen again, and say what does it resemble ?

Dear, dear, dear,
    In the rocky glen,
Far away, far away, far away,
    The haunts of men,
There shall we dwell in love
With the lark and the dove,
Cuckoo and corn rail;
Feast on the banded snail,
    Worm, and gilded fly ;
Drink of the crystal rill,
Winding adown the hill,
    Never to dry.
With glee, with glee, with glee,
    Cheer up, cheer up, cheer up; here
Nothing to harm us; then sing merrily,
    Sing to the loved one whose nest is near.
Qui, qui, qui, kween, guip,
Tiurra, tiurra, chipiwi,
Too-tee, too-tee, chiu, choo,
Chirri, chirri, chooee,
Quiu, qui, qui.

"No more, pray; the Thrush's song is indescribable and inimitable. It is heard at all seasons in fine weather, but especially in spring

and summer, particularly in the early morning and about sunset. But it is not in sunshine only that this gentle songster warbles its wild notes; for often in the midst of the thick rain it takes its stand in some sheltered spot, under the cover of a projecting crag or stone, and for hours perhaps amuses itself with repeating its never-tiring modulations."

We are all familiar with the Starling, Sturnus vulgaris, with its bustling noisy greedy ways, walking or running instead of hopping, giving little cries or screams and eating at one mouthful enough for a dozen sparrows or twice as many titmice. Seen close the plumage when most brilliant is very striking and handsome, splendidly glossed in different lights with purple, bronze, copper colour, gold and green, but at a little distance the starling, as usually met with in towns, looks dark and sombre and generally very untidy. On our lawns in winter this bird has funny fussy ways, ten or twenty alighting at once to eat the crumbs of bread, and a piece that appears to be about a quarter the size of the bird will be taken quickly into the beaks and swallowed at once. About the end of June, Starlings, being gregarious birds, begin to collect together in flocks of twenty or thirty, and as the season advances each of these is severally added to by recruits from other families, who join them in their flights, and so the original party gather like a snowball until in the end a vast mass is congregated.

The Blackbird, Merula merula, or Turdus merula is another well-known resident in our towns, numbers of them breeding in the shrubs found in the different public and private gardens. The song is something like that of the Thrush but rather louder, and perhaps with a fuller tone. On the approach of danger the Blackbird utters as do several birds a peculiar note which as indicative of alarm must attract the attention of all who bear it. In our gardens it generally signifies the presence of a cat, often that the cat has caught and killed one blackbird when its mate will continue the screams of alarm for a long time afterwards. His song is said to be a deep contralto warble and pipe with a call of pic, pic, pic. The male is black with a yellow bill, the female brown with a brown bill, they both look very handsome on the snow, but they are much more timid than Starlings.

The Chaffinch, Fringilla cœlebs, is a charming little bird with its clear little note like pink, pink, and its brilliant plumage of brick red and bluish grey. It has a bright sprightly hop, and a busy fussy manner, as though it rather despised the common sparrows that may be picking up crumbs on the same grassy lawn. Like the Blackbird it is seen to the greatest advantage on the snow when the red breast, as bright as a robin's looks more handsome than usual with the contrast of blue, walnut, white, and yellow on the head, back, wings and tail. Although in the town one may see twenty

sparrows to one chaffinch, in the country lanes the chaffinch is often commoner. Its food is generally grain, seeds, and the tender leaves of young plants, but in the spring insects contribute to its dietary, and some years ago I stood on a little footbridge over the river Tweed, near Dryburgh, and watched the Chaffinches catching insects in the air, like so many Flycatchers. The female bird is not nearly so handsome as the male, the brilliant colour being all toned down, and the red breast almost absent. I am not very familiar with nests, but that of the Chaffinch is said to be most perfect in finish and general workmanship, taking the female bird sometimes three weeks to build.

Who does not love the Robin, Erithacus rubecula; the first favourite of English birds? What tales are told of his tameness and pleasing little ways in our gardens, on our window sills, and even in our rooms if tempted by a few crumbs and an open window. John Ruskin, in "Love's Meinie," the first of a series of Lectures on Greek and English Birds, given before the University of Oxford, after seventeen pages of severe satire on the aristocracy for shooting birds and especially pigeons, on the masters of science for their arrogance and materialism, and methods of nomenclature, and on some articles for their love of minuteness and muscularity, or as he puts it, "the lancet and the microscope in the hands of fools supposed to be substitutes for imagination in the souls of wise men" at length says "And yet I am going to invite you to-day to examine, down to almost microscopic detail, the aspect of a small bird, and to invite you to do this, as a most expedient and sure step in your study of the greatest art. But the difference in our motive of examination will entirely alter the result. To paint birds that we may show how minutely we can paint, is among the most contemptible occupation of art. To paint them, that we may show how beautiful they are, is not indeed one of its highest, but quite one of its pleasantest and most useful; it is a skill within the reach of every student of average capacity, and which, so far as acquired, will assuredly both make their hearts kinder, and their lives happier. Without further preamble, I will ask you to look to-day, more carefully than usual, at your well-known favourite, and to think about him with some precision." Further on he mentions, "the indescribable silky brown, the ground work of all other colour in so many small birds, which is indistinct among green leaves, and absolutely identifies itself with dead ones, or with mossy stems. I think I show it you more accurately in the robln's back than I could in any other bird; its mode of transition into more brilliant colour is, in him, elementarily simple." Again, "he is very notable in the exquisite silence and precision of his movements, as opposed to birds who either creak in flying, or waddle in walking. "Always quiet" says Gould, "for the silkiness of his

plumage renders his movements noiseless, and the rustling of the wings is never heard, any more than his tread on earth, over which he bounds with amazing sprightliness." You know how much importance I have always given, among the fine arts to good dancing. If you think of it, you will find one of the robin's very chief ingratiatory faculties is his dainty and delicate movement,—his footing is featly here and there. Whatever prettiness there may be in his red breast, at his brightest he can always be outshone by a brickbat. But if he is rationally proud of anything about him, I should think a robin must be proud of his legs. Hundreds of birds have longer and more imposing ones—but for real neatness, finish, and precision of action, commend me to his fine little ankles, and fine little feet; this long stilted process, as you know, corresponding to our ankle-bone, commend me, I say, to the robin for use of his ankles —he is, of all birds, the pre-eminent and characteristic Hopper; None other so light, so pert, or so swift." Talking of the feathers "I have no doubt the Darwinian theory on the subject is that the feathers of birds once stuck up all erect, like the bristles of a brush, and have only been blown flat by continual flying. Nay, we might even sufficiently represent the general manner of conclusion in the Darwinian system by the statement that if you fasten a hair brush to a mill-wheel, with the handle forward, so as to develop itself into a neck by moving always in the same direction, and within continual hearing of a steam whistle, after a certain number of revolutions the hair brush will fall in love with the whistle; they will marry, lay an egg, and the produce will be a nightingale." Again "let us examine a feather from his breast. I said, just now, he might be at once outshone by a brickbat. Indeed, the day before yesterday, sleeping at Lichfield, and seeing, the first thing when I woke in the morning (for I never put down the blinds of my bedroom windows), the not uncommon sight in an English country town of an entire house front of very neat, and very flat, and very red bricks, with very exactly squared square windows in it; and not feeling myself in any wise gratified or improved by the spectacle, I was thinking how in this, as in all other good, the too much destroyed all. The breadth of a robin's breast in brick-red is delicious, but a whole house front of brick-red, as vivid, is alarming. And yet one cannot generalize even that trite moral with any safety—for infinite breadth of green is delightful, however green; and of sea or sky, however blue. You must note, however, that the robin's charm is greatly helped by the pretty space of grey plumage which separates the red from the brown back, and sets it off to its best advantage. There is no great brilliancy in it, even so relieved; only the finish of it is exquisite. If you separate a single feather, you will find it more like a transparent hollow shell than a feather (so delicately rounded the

surface of it),—grey at the root, where the down is,—tinged, and only tinged, with red at the part that overlaps and is visible; so that, when three or four more feathers have overlapped it again, all together, with their joined red, are just enough to give the colour determined upon, each of them contributing a tinge. Innumerable are the tales told of Robins especially bearing on three points, their tameness, familiarity, and friendliness with man, their pugnacity with other birds in general and with their own species in particular, and the remarkable sites chosen for their nests. I will just mention some of these sites. A hole in the mizen mast of the Victory made by a cannon ball; a myrtle in the hall of a house, this being stopped; the cornice of the drawing room, this being stopped; a new shoe on a shelf in the drawing room, this being nearly completed was removed by the owner of the shoe to an old shoe, after which the nest was finished, the eggs laid and duly hatched. A shelf in a pantry amongst bottles, the pantry being visited once or twice every day when the bird would only fly on to the floor; the head of a shark in a museum. The festoons of curtains in a dining room. A pigeon-hole bookshelf in a school constantly frequented by seventy children. The large Bible on the reading desk of the parish church of Hampton in Warwickshire. A similar place in Collingbourne, Kingston Church, Wiltshire, the cock bird feeding its young during service. A letter box on a gate post, &c. &c. There is a popular error that the cock robin alone has a red breast, but the fact is that the plumage of the two sexes is practically alike.

The Sparrow, Passer domesticus, is the proverbial figure of commonness and worthlessness, and yet it is a very interesting bird. Not nearly so trim or brightly coloured as the robin, not usually so friendly, with no pretty song, yet the sparrow has many interesting ways, and we should speedily miss him if he failed to frequent our gardens and streets. The town birds suffer much in their plumage from the smoke and frequent contact with chimneys and bricks and mortar in general, but when the young birds have just attained to their brightest full-grown colouring, they are by no means the dingy sombre, ragged and torn specimens that so often come for our crumbs in winter, the head, neck, and wings have many fine and various shades of brown, making prettily curved and variously shaped figures from the head to the tail. Many an invalid in bed has been cheered by our untidy and smoky little friends chirping and feeding on an out of the way window sill which rarer birds will not frequent. The following quotation is I think very discriminating:—" Wherever this bird is met with, his character is much the same—bold, pert, and familiar; instead of the gentle and pleasing confidence displayed towards the human race by the Redbreast, the Nightingale, the Redstart, and some

other small birds, the Sparrow shews a bold disregard that is far from engaging our affections ; as if our kindness and our enmity were alike despised. Instances are not wanting, however, of great attachment on the part of caged Sparrows for persons by whom they have been reared."

The last bird that I shall bring before you to-night is the Blue Tit, Parus cœruleus, a charming little creature, and one of the most interesting and amusing of birds. Its total weight, feathers and all is under half an ounce. Its plumage is very pretty indeed and almost brilliant, but in the town it suffers from the smoke like other birds, and the brighter and whiter colours get very dark and dirty. The most interesting of its habits are those connected with its climbing and hanging on to the twigs, branches, or whatever else it clings to. It seems generally to prefer being upside down, and it twists and turns and pecks, and drops off or flies off all with such rapidity that the eye can scarcely follow it. If it succeeds in getting a nice piece of suet or a crumb of bread in its beak it will fly away with it to a neighbouring branch, and there holding it with the claws of one foot against the branch peck away at it and enjoy it in the prettiest, daintiest way imaginable, like a hawk with its foot on its prey in miniature. The Blue Tit is very pugnacious, and very bold, often pecking vigorously at a bird ten times its size. Its nest has been built in most remarkable places, and the eggs hatched, and the young fed and brought up under circumstances of extraordinary difficulty. I have myself seen one flying in and out of the top of a gas lamp in Coolinge Road which was lighted every night. But sometimes the bird has had to fly positively through the flame to get in and out. The inside of a wine bottle with a long neck has sufficed for the successful hatching and bringing up of one family. The most effectual means that I know of for watching the amusing ways of this little bird is to hang a piece of suet placed on a small piece of wire on to the branch of a tree near one's window. Fifty or a hundred times a day will this be visited in a favoured spot by this bird, and no other except its three relations, the Great Titmouse, Cole Tit and Marsh Tit. I will conclude this disjointed paper with a short poem of the late Lord Tennyson which I select because of its pleasing references to the world of Nature.

> The rain had fallen, the Poet arose,
> He passed by the town and out of the street,
> A light wind blew from the gates of the sun
> And waves of shadow went over the wheat
> And he sat him down in a lonely place,
> And chanted a melody loud and sweet,
> That made the wild swan pause in her cloud,
> And the lark dropt down at his feet.

The swallow stopt as he hunted the bee,
The snake slipt under a spray,
The wild hawk stood with the down on his beak,
And stared, with his foot on the prey,
And the nightingale thought, I have sung many songs,
But never a one so gay,
For he sings of what the world will be
When the years have died away.

In proposing a vote of thanks Mr. Walton asked the lecturer if he knew whether the "Butcher Bird" (*Lanius excubitor*), ever visited this neighbourhood.

Dr. Eastes said he had not seen it, nor was it recorded in the Secretary's "Rambles round Folkestone," the list in which was drawn up a few years ago by Mr. F. Tolputt, a keen observer of birds.

The Secretary seconded the vote, remarking in reference to Mr. Walton's question that *all* our Shrikes are popularly known as "Butcher Birds," and that one, the Red-backed Shrike (*L. collurio*) was very common here.

February 21st.

The weather was again very unfavourable, but there was a very fair attendance. Microscopes were brought by the President, and Messrs. Hills, Peden, Rutt, and Hambridge, and several interesting exhibits were shown. Also on the table were :—

Variations in the Drinker Moth ...	Mr. Hills
Collection of Canton Grasses ...	Mr. Walton
Red backed Shrike	Mr. H. Ullyett
Great Grey Shrike	Dr. T. Eastes

The last was of great interest because of the question asked at the previous meeting.

Bohemian Waxwing from Canada ...	Dr. T. Eastes

March 21st.

Thirty members present. Mr. Walton read the following paper, entitled

TWENTY YEARS' BOTANIZING ROUND FOLKESTONE.

Since the spring of 1873 the face of the neighbourhood has changed very much indeed, and the changes that have taken place are not of a kind to bring much satisfaction to the mind of a botanist. I can speak to you of things as they used to be as well as of how they now are. Twenty years ago the Sandgate and Sandling branch railway was being made. There was a patch of fruitful ground just at the end of the Sandgate Parade (the road by the sea

between Seabrook and Hythe was not thought of); the slopes of Shorncliffe Camp were not cut about as they now are; the Upper and Lower Sandgate Roads and the cliff walk were not made as they now are; the Warren of 1873 was very, very unlike the Warren of to-day—in short, changes have been very numerous in all directions. The neighbourhood is, of course, called a growing and improving one, but it makes all the difference who is judge in such a matter. Trim, beautifully-kept roadsides and walks are right enough, no doubt, but they are a sore trial to the man who takes his walk, not to study asphalte, but to learn what wild nature has to say to him of Divine wisdom and power. The pleasure to be had by the man who simply goes for a walk is as nothing by the side of the delight which a student of nature finds in trying to read the story book, as he sits, so to speak, upon the knee of "Nature, the old nurse." It may be that some of you mean to take more notice than you have done of things that grow about here, and mean to study them more, that you may be able to add to the interest of the meetings of the Folkestone Natural History Society. Let no one think that botany is a dry, unbearable sort of thing—that it is a thing not to be enjoyed until the hedge of long, ugly words and definitions has been broken down. It is a study that should be practical from the very first, no branch of it being attempted unless one hand holds the specimen and the pocket magnifier, while the other holds the book. But these general remarks must be sufficient, as you will be wanting to hear other things. The late Mr. H. C. Watson, the author of "Topographical Botany" gives us a map of Britain, divided into 18 provinces, 38 sub-provinces, and 112 counties and vice counties. Province III. is the Thames province, of which the sub-provinces are the South Thames, the North Thames, and the West Thames. The vice-counties in the first of these three are East Kent, West Kent, and Surrey. Our concern is, of course, with only a part of East Kent. "Topographical Botany" is a very useful book of reference, as it gives the number of each vice-county in which any species has been reported to grow; vice-county No. 15, for instance, is East Kent. It is easy to see that in any attempt to put together a list of the plants growing round Folkestone or found in this neighbourhood, some lines must be drawn somewhere, else the word "local" does not apply. How far afield may a botanist or an entomologist travel without getting too far from his starting point? Now, as the sea on the south says "Thus far shalt thou come" it seems only fair to deal literally with the rambler when he goes forth eastward, westward, or northward. If he should ask you to let Barham be the limit on the north, Dover on the east, and Westenhanger, or a place called Gibbons' Brook, on the west, what will you say? And will you throw in the sea coast westward as

far as Dymchurch ? I ask these questions because I have, very imperfectly no doubt, trodden a good deal of the ground, and met with much success, eight or nine miles away, especially, perhaps, westward. Here is a very interesting map of Kent, divided, according to the geological formations, into a number of botanical districts. District 7 is thus described: "Entirely chalk; sea coast, high chalk cliffs, and undercliffs." District 10, thus: "Lower greensand; Weald, clay and alluvium; sea coast, shingle and blown sand in south." It would be very instructive to make two lists, one of plants from the chalk, and the other of plants either not found at all, or not in perfection, on the chalk. Our chalk flora is a truly typical one, not differing greatly from that of any similar district in the South of England. This is a fact to be noted. The following are a few of the well-known plants which I do not remember having seen off the chalk in this neighbourhood:—Linum catharticum, Anthyllis vulneraria, Rosa rubiginosa, Asperula cynanchica, Galium tricorne, Carlina vulgaris, Cuicus eriophorus, or Picris hieracioides. Most of these are abundant in the Warren. The following are a few species which I have not observed on the chalk in this neighbourhood:—Dianthus armeria, Genista anglica, Trifolium arveuse, Trifolium filiforme, Spiræa ulmaria, Smyrnium Olusatrum, Solidago Virga-aurea, and Digitalis purpurea. I speak, however, without notes, and it is very possible that some one present will have a word to say on this matter. Most certainly many species do well in soils of very different composition. The common red poppy may be given as an illustration. Situation must not for a moment be lost sight of, as many plants are content in dry places, without reference to the nature of the soil, and many others do well so long as they are in damp places. There is very little spongy bog land about here. One tract of some extent, not far from Westenhanger, has a very typical bog flora, and offers a delightful time to anyone who has botanized chiefly on the chalk and the uplands. The chalk cliff, especially near Dover, is gay with the wild cabbage (a rare plant), and the less showy but useful samphire is there in plenty too. There also is the Nottingham catchfly (Silene nutaus) and the stiff sea lavender (Statice binervosa), the wild beet (Beta maritima), the wild carrot (Daucus Carota), the wild mignonette, and many another. In the Warren the most striking species are the sweet briar (Rosa rubiginosa) and the showy-flowered wayfarer's tree (Viburnum Lantana), the traveller's joy (Clematis vitalba), and the rare sea-buckthorn, with its autumn display of red-currant-like berries. Amongst the most abundant plants, are certain of the Leguminosæ, notably the pretty kidney vetch or lady's fingers (Anthyllis vulneraria), and the well-known bird's foot trefoil (Lotus corniculatus). These two are quite a study in yellow of different shades. I think the kidney vetch is

a beautiful plant; there is a soft loveliness about it, and by no means a sameness, for departures from the common form are frequent. Of autumn flowers, the Warren has a good supply of yellow Composites, Devil's-bit Scabious, and Gentian. Blackberries would be there if they had a chance to get black. The lower greensand cliff, under the Lees, is still interesting to the botanist, but it is getting less so every year, in spite of "notice" boards. The frequent slips mean much change, and the planting of firs means the gradual ruin of the flora. At present, the features are the great abundance of Black Mustard, an imported plant of the Cruciferous order (Lepidium Draba, a kind of cress), and a quantity of a fœtid yellow-flowered Umbellifer, called Alexanders (Smyrnium Olusatrum). The last is thick just above the Bathing Establishment. The pushing Lepidium is already in sole possession of a good deal of ground, and it is increasing fast in other parts of the county. Twenty years ago it was not on our cliff at all, being confined to the south side of the Lower Road. The tall, coarse black mustard (Sinapis nigra), with its yellow flowers, is almost "too much of a good thing." Its black seeds, mixed with those of white mustard, go to make the mustard of our tables. Wild mustard, or charlock, known in East Kent as "kinkle," occurs in gardens and waste places at Folkestone. It is to the farmer a very troublesome weed. On the Lees cliff there is a great deal of Chervil, not wild Chervil, but the kind that was once much prized as a pot herb, but has, like many good things in this world, gone out of fashion. Five or six years ago one of the wild Lettuces (Lactuca virosa) appeared on the cliff west of the Lift. It is a tall plant, with a milky juice, and yields a strong extract, having decided sedative properties. Years back I saw the plant growing on the beach at Lydden Spout, so it seems to have come to us from there. On the banks of ditches west of Hythe the Marsh-mallow (Althea officinalis) still grows. This velvet-leaved plant, with its handsome pink flowers, is one of our treasures. Its root is still largely used, but chiefly on the Continent, as a useful medicine. People call the first roadside mallow they see marsh mallow, just as they called the common dulcamara deadly nightshade. Atropa belladonna, for such is the name of the deadly species, does not grow in this neighbourhood, although it might, as it is fond of chalk. Our woods (and there are some large ones not very far off) are gay with primroses, anemones and blue bells. The fragrant woodruff is there, the Herb Paris too, the curious Green Hellebore, the early purple Orchis, Solomon's seal, the Butterfly Orchis, the Lily of the valley, Foxglove, and many another. To me, colour in flowers has been more interesting since I read the hypothesis that says, "All flowers were at first green; from this they diverged to yellow and white. Their next advance

was to shades of red; their triumphant colour—their final stage in chromatic evolution—is blue." This ought, at any rate, to make it clear to us that flowers are like ourselves—very imperfect; for blue flowers are not plentiful. White *varieties* are numerous. I have found the common Bluebell in white, also the Gentian, the Primrose, the bush Vetch, several orchids, and others. I have also found flowers, chiefly of the buttercup order, more or less double. The commonest buttercup of our meadows is Ranunculus bulbosus, with generally five petals, but I have found flowers growing in the open meadow, some with five petals, some with six, some with seven, some with eight, and a few with ten. Only in a few cases was it clear that petals were being formed at the expense of stamens, for the doubling of a flower is the conversion of stamens into petals. In wet seasons, the common White Clover is given to a singular freak, for, as if to prove that books are right when they speak of calyx and corolla *leaves*, it will turn out sham flowers made of green leaves twisted about. I have not yet been there to see when any plant of any description has turned into some other plant. Amusing as is the thought of such a thing to us, it was formerly believed that in bad seasons corn might change its nature quickly; might, that is to say, turn into noxious weeds Evolution is nowhere by the side of this. Some time ago a good man wanted to find out if I knew a certain plant. His effort to make his meaning clear in his complete ignorance of botanical terms was very amusing. At last he said "Well I did want to know, because I believe that on my land the seeds of that plant grew up into something else." This story is only one of a number, but it must suffice, except for this: A countryman was looking admiringly at some plants which I had found very near his own house, and put them into his hand with the question, "Aren't they lovely?" He said, "Yes, they be; but them doan't grow in these parts, do 'em?" "Oh, yes, they do. Most likely you have trodden on such many a time." "Well, then," he said, "I must a bin about all these years wi' my eyes shut." How many species of plants grow in this neighbourhood? Have you decided what is the neighbourhood? And what book is to be followed? And what is to be called a species? Whether this or that should be called a *species* or something else is not a part of my subject. Specific characters are as interesting as they are important, but by no means always easy to make out, and intermediate forms are not a help to a student, but a perplexity. No one, however, can try to see points of agreement or of difference between things, whether plants or not, without benefiting by the use of the observant faculty. But enough of general observation, for it is time I told you something definite about the extent and variety of our flora. It is a matter of counting up and arranging under their natural orders our

flowering plants, ferns, and horsetails, with the London catalogue of British plants, Part I., as our guide. This useful little book aims at giving a fairly accurate list of plants. The last edition, the eighth, is dated 1886, and the editor is Mr. F. Hanbury. It is based on the "Genera Plantarum," a great work completed only a few years ago. The first edition was issued in 1844, and the list has gone on lengthening. Edition seven, published in 1874, reaches 1665 flowering plants, ferns, and horsetails; but the eighth edition gives 1821, besides many varieties—an increase of 156. To account for this increase, and get much information as well, read the "Explanations" of the editor. I have ticked off as actually found about 698 species and varieties. Taking some of the strongest natural orders, as far as British plants are concerned, I am able to give the following statement, which may be fairly correct. The plants, as to their *habitat*, may be classed as "chalk," "fluviatile," "sylvan," "bog," and "marine." Such as occur on the top of the Downs are only dwarfed forms of plants that grow at a lower level:—

	Plants numbered in the Catalogue for the whole of Britain.	Plants found in this neighbourhood.
Compositæ	169	62
Graminacæ	135	60
Rosaceæ	129	23
Cyperaceæ	106	25
Leguminosæ	87	51
Cruciferæ	83	25
Caryophylleæ	69	32
Umbelliferæ	69	75
Labiatæ	61	28
Scrophulariaceæ	59	26
Filices	50	14
Ranunculaceæ	46	21
Orchideæ	44	20
Naidaceæ	43	6
Linaceæ	36	7
Salicineæ	35	7
Polygonaceæ	32	12
Juncaceæ	30	9
Chenopodiaceæ	26	11
Boragineæ	26	13
Saxifrageæ	24	5
Geraniaceæ	23	10
Primulaceæ	21	11
Rubiaceæ	19	12
Ericaceæ	19	4

Six of these orders are mono-cotyledonous, and it will be seen that, excepting grasses and orchids, they are all poorly represented. The terms "common," "frequent," or "rare" are very convenient to put after the name of a plant, and other terms, such as "an alien," a "casual weed," "an introduced plant," or "indigenous," as the case may be, have their value to the student. Some of the returns are good, as, for instance, the 62 out of 169, the 60 out of 135, and especially the 51 out of 87. In several cases nearly half the British species are with us, in others a much smaller proportion. The 23 Rosaceous plants out of 129 are explainable, for the one genus Rubus (Blackberry) is credited in the London Catalogue

with as many as 61 species. Truly the species, rightly or otherwise, are themselves as plentiful as blackberries, but I do not know how many of these papers grow about here. Dr. Johnson, when once asked a question by a lady, confessed that he did not know by answering "Sheer ignorance madam, sheer ignorance." This statement before you must not of course be taken as accurate, but only as something near the mark, and as near, at any rate, as some amount of care can make it. Some plants are fitful and uncertain, appearing and disappearing curiously, and "turning up" where they had not before been seen. There is evidence, toc, that the seeds of some species will lie long in the earth without germinating, so that you may often find the unlooked-for where the ground has recently been disturbed again. Seeds are carried by the wind and brought by the birds into fresh districts, and there are other agencies concerned in the distribution of seeds. Therefore it is not possible for any one to say that this year's flora in any given spot will be the same as last year's. The size of a plant makes no difference to a student; a small thing gives as much pleasure and is as good a "find" as a large thing. The eye that is trained readily sees some new form, although it may be so small that another eye would not detect it at all. A few of our small plants are very plentiful, and on account of their tiny flowers and prostrate mode of growth they have to be looked for rather carefully. Such are several species of the Trifolium genus and some other of the Leguminosæ. I have purposely left till last one matter which concerns students generally, and which relates broadly to the fauna as well as to the flora of this and pretty well every other district—country, I may as well say. The wanton destruction that goes on is something shocking. The "Goths," the "Philistines," are bent upon exterminating things, and the result is that many are surely disappearing. As to this neighbourhood of ours, I can speak from actual observation. What chance do our graceful ferns stand against the horde of collectors who gouge them up by the dozen and sell them at our doors? Where will the better known of our Warren plants be in a few years? Where are our orchids going? Nearly twenty years ago I found, for the first time, the beautiful Bee Orchis, not far from there. It was growing in some profusion at that spot, but to-day it is not there. Of course the more the public take to a plant, the less is its chance of life, and the more scarce a plant becomes, the more likely it is to be lost entirely. In my hand is "English's Guide to Folkestone, Sandgate, and the Neighbourhood, published in 1875." It contains a list of some of our rarer plants, probably (but I do not know) taken chiefly from published floras of East Kent. That list gives about 75 plants, nearly all of which I have found at some time or other, adding, however, a good many that ought to have been given a place as

well. Now, of those 75, some are to-day very abundant, but about a dozen would require a great deal of looking for. The interesting "Rambles of a "Naturalist," by our worthy Secretary, would, perhaps, bear revision, as far as its list of plants is concerned; although, for reasons touched upon in this paper, it does not do to use the pruning knife too freely. A few additions might be made. Some people collect plants, and some study and love them. Collectors dig up roots to any extent, but botanists—real botanists—gather most sparingly, and not at all if specimens are very scarce. Remember a botanist is a person in love with what is called nature, and is not a destroyer. And now, to conclude, this paper is not a deep one, nor was it meant to be. What there is in it in the way of fact, as a result of twenty years' experience, could be amplified and made much more worthy the attention of any scientific botanist. My last word is one of thanks for plants, which I had not before seen in the neighbourhood, received from Dr. Thomas Eastes, Mrs. Eastes, Mr. Nicholson, Mr. Jenner (of Sandgate), and Mr. Ullyett. I shall be very glad to name local specimens for anybody, as far as may be in my power.

Several questions were asked afterwards and replied to by the lecturer, and the usual vote of thanks was awarded. The President was absent through illness.

April 11th, 1897.

About sixty members were present, the President in the chair. The Secretary read the following paper on

THE INFLUENCE OF GEOLOGY AND GEOGRAPHY UPON HISTORY.

"Man," it has been said, "is the creature of circumstances." This aphorism, taken by itself, conveys a decidedly wrong impression; in consequence it has been, and still is made, the ground of very erroneous conclusions, especially in reference to moral responsibility. If the assertion were made in reference to the lower animals only, there would be little or nothing to say against it; and in fact it is the chief article in the creed of the Survival of the Fittest. But so far as human beings are concerned, it has to be checked and modified by a well-known fact, viz:—that man has the power of controlling circumstances,—that he can to a large extent guide them, and even arrange them for himself. Thus,

and so far, he is responsible for the results of his circumstances upon himself. We cannot say this of the animals below him; they lack this power of guiding and arranging; in modern paraphrase, they are the result of their environment—of their physical surroundings. This environment, as it changes through the ages, so re-acts upon them that they are compelled either to change also, or else to disappear. But man, in his proud self-consciousness, in spite of all the metaphysician and the philosopher may say, thinks and feels himself to be well-nigh independent of his surroundings,—that he is ruler and lord of the earth,—that he can shape his own destinies.—and that if he cannot altogether resist physical influences, as indeed he would not wish to do, he can to a large extent choose them for himself.

Not altogether so; yet at the present time it is true to a greater extent than it has ever been before. Now, in this age of science, theoretical and practical, he laughs at nature, scorns her power, and compels her to serve him. The massive mountain ranges have no terror for him; he bores holes through them, calls them tunnels, and rides through them on his iron horse. The sea does him service by bearing up his fleets for commerce or for war; even the *depths* of ocean have been compelled to yield up their secrets to him, and he is quite prepared to bore holes even down there. Distance is nothing; he talks audibly with his friend 500 miles away, he has harnessed the lightning, and forced it (in a milder mood) to carry his messages round and round the globe. Certainly now, if ever, it is true only to a small extent, that "man is the creature of circumstances."

But it was not always so,—certainly not in the old stages of man's history. The farther back we carry our studies in the development of mankind, the less able we find him to control or even to guide the circumstances of his environment; the more we find him controlled and guided by nature itself, until at last we see him raised only a little above the level of the other creatures, as much acted on by his physical surroundings as any of them. And then he developed in different directions, along different lines; according to these influences, the man of the hot plains of India developed differently to the man of Siberian wastes; the man of the mountain and plateau differently to the man of the valley and plain; the man of the forest differently to the man of the dreary steppes. And hence we find tribes possessing different characters, differing in powers and capabilities;—some energetic, prepared to overcome *any* difficulty that may present itself; some, always ready to give way under it;—one country noted for its patriotism its "Courage never to submit or yield;" another for its pusillanimity;—one people marked out for empire and victory, another fit only to be slaves.

In some parts of the earth nature is kind and bountiful; often too much so. Life is easy and simple; there are few wants, and these are easily supplied; no exertion is necessary, and so no exertion ever developes itself. No high civilisation has ever arisen in a tropical region. Referring to this, Mr. Buckle says:—"In Asia, civilisation has always been confined to that vast tract where a rich and alluvial soil has secured to man that wealth, without some share of which no intellectual progress can begin. This great region extends with a few interruptions from the East of South China to the West Coasts of Asia Minor, Phœnicia, and Palestine. To the North of this immense belt there is a long line of barren country, which has invariably been peopled by rude and wandering tribes who are kept in poverty by the ungenial nature of the soil, and who, as long as they remained on it, have never emerged from their uncivilised state. Yet those same hordes have at different times founded great monarchies by invasion, *e. g.* China, India, and Persia. There they found the materials of wealth, and there consequently they acquired some degree of refinement, produced a national literature, and organised a national policy, none of which things they, in their native land, had been able to effect." ("Hist. Civilisation).

In other parts nature is so harsh and unkind that she yields nothing to labour. Man gives it up, makes no more attempts to conquer her, and hence we find thousands of square miles in such districts as waste and barren as they were 10,000 years ago. But where she is bountiful in her returns to labour and perseverance, and only to them, there she developes peoples of steady, determined, and untiring energy, persevering and self reliant. In such localities have arisen the nations that have conquered the world.

Slowly and gradually has man emancipated himself from the overwhelming difficulties of his surroundings; not even yet has he become completely independent of them, and certainly, I may venture to say, he never will, so long as diversity of surface, climate, and soil shall exist—so long, that is to say, as the geological agencies of past and present times shall continue to act. And this brings me to the more immediate point of this lecture. What are these "circumstances" which produce such diversity of character among nations, such variety of pursuits even among the inhabitants of the same country? Already I have referred them to physical surroundings, *i.e.*, to the geography of the country. This physical geography is dependent on, and only to be explained by, geological action. The two are most intimately connected, so much so that it is impossible to draw a dividing line; they are in fact, two aspects of one science, and so, throughout what I have to say, I shall be alternating between the two, though I trust, without any resulting confusion.

"Every country," says M. Ragozin, in his history of Chaldea, "makes its own people," *i.e.*, he goes on to say, "the mode of life and the intellectual culture of a people are shaped by the characteristic features of the land in which it dwells." One calls to mind at once, in illustration of this, the patriotic Swiss and Highlander, the "hardy Norseman" of Scandinavia, and, generally, the persevering people of the North temperate regions. And we contrast them with the more enervated ease-loving nations dwelling under a tropical sun, in a paradise of luxury, lotus-eaters, living in

> "A land
> In which it seemed always afternoon,
> A land where all things always seemed the same."

Compare for a moment the native civilisations of India and Greece. In the former country the works of nature are of startling magnitude—sublimely and awfully grand, often terrible and threatening. The early peoples were intimidated by them, the huge snow-clad peaks, ranged in tiers rising one behind another,

> "Crags, knolls, and mounds, confusedly hurled,
> "The fragments of an earlier world"

the flooded rivers, the impassable forests, the swamps and jungles, where it was death to tread, all awed them with their known and still more with their unknown terrors, and taught them their own feebleness. Hence the character of their religion, their impossible and altogether unhuman gods, hundred-headed monsters—a religion altogether based on terror.

In bright sunny Greece on the contrary, the varied and smiling aspect of natural phenomena, not too huge, the happy climate, the blue sea, and the variety in its coast line, inspired no terror, confidence rather than fear. Nature tempted them to examine, not to avoid. They studied under her, and physical science became possible. And so the Grecian mythology had nothing terrible about it; its gods are human, very human, with human attributes, tastes and pursuits, not always it is true of a very high order. We might also compare the architecture of the two countries, and note the effect of physical geography upon that; producing the huge massive temples of early Indian times, and the light pleasing structures of ancient Greece. Art, too as you know, reached a perfection there, from which we are told, it has ever since been declining.

Take another illustration. How shall we account for the roving disposition which has characterised the Bedouin Arabs from the time when "Ishmael became a wild man" up to the present hour? And along with it as a necessary consequence, all their well known bravery, hospitality, generosity, and love of plunder? Their country made them what they are "They cannot," says Ragozin, "build cities on the sand of the desert, and the small patches of

pasture and palm groves, kept fresh and green by solitary springs and called oases, are too far apart, too distant from permanently peopled regions, to admit of comfortable settlement." It certainly is not the inherent character of the people themselves: for where they have migrated to more favoured districts, *e.g.*, North Africa, or the seashores of Arabia, they have become a totally different people, "model husbandmen," and builders of cities. That branch which passed across into Spain to assist in revenging the insults of Roderick the last of the Goths, settled there and made the Plain of Andalusia one of the paradises of the earth, smiling with produce, picturesque with its Moorish towns, palaces, and temples. For years they took the lead in Europe in literature and science. It was only at the beginning of the 8th century that they crossed the strait, yet at the time our Alfred was minding cakes in the marshes of the Somersetæ, there were in Cordova alone 80 free schools and 900 public baths. Contrast the effect of Spain upon these Moors with the state of their brethren of the wilderness and desert, whose wanderings were, and are, a very necessity to them, and among whom as a consequence, no high culture can possibly arise.

Contrast also with these wandering Arabs the Chinese and their past history—a fixed nation, steadily refusing to mix with others, bent on keeping to themselves what civilisation they had achieved, and declining to share that of the "barbarian" world outside. How was this? Look at the geology and geography of China. Separated on the land side from other nations by massive up-thrown highlands, almost impossible of passage for themselves, and forming at the same time a bulwark against invasion; living in a land which literally produced everything they required either for food or for clothing, there was no necessity, and no inducement for maritime commerce; they lived for ages in contiguity with the civilisation of India without sharing in it, probably without knowledge of it, and remained more than contented with their lot, "dwelling" like the Shunamite "in their own country."

To return to India again. Contrast its climate and physical aspects with those of the plateau beyond the huge barrier to the north. One country warm, pleasant, luxuriant in its vegetation, the soil yielding with comparatively little trouble everything man could desire; the result, enervated energies and love of ease. The cold, bracing highland of the north rearing a warlike race, who now and then looked with envious longing eyes on this rich garden to the south of them, and now and again swept round through the mountain passes and took possession of all that the feeble folk could not defend. After a time these conquerors in their turn gave way to seductive nature, and were overwhelmed by a fresh wave from the north. Hence the complexity of races which we find in India, now all brought under the dominion of a people who have triumphed

over nature. I am sorely tempted to multiply these interesting examples; but it will be preferable to limit what remains to be said to the annals of our own country.

First, let me draw your attention to the immediately prehistoric geography of the British Isles as shown on this map. We have them represented as at one of the stages of what the geologists call "The Pleistocene Period." You see that our islands, which are now about 1,000 in number, then formed a connected area, and they were undoubtedly a part of the continent of Europe. The coast line, notice, stretched much farther to the north and west than at present—200 or 300 miles west of Ireland, and thence onward to the inner angle of the Bay of Biscay. All the sea within this line at the present time is less than 100 fathoms deep, but immediately outside it sinks rapidly to several thousand feet; this line then is in reality the true north-western coast line of Europe, and the British Isles rise from the enclosed area as from a submarine plateau or platform. If an elevation of 600 feet were to take place at the present time, this state of things represented on the map would be restored. Let me point to one or two interesting features in the map. The modern North Sea was a broad undulating plain, rich in vegetation, the feeding ground of the herds of animals whose bones and teeth now lie scattered over its bed in profusion. The Dogger Bank, one of our great fishing grounds was "a part of western Europe, its southern and western sides washed by the waters of a large river," coming from the south and flowing onwards to the deeper parts of the sea. That river was the Rhine, which then received the Thames and all the rivers of eastern Britain as tributaries. The English Channel had no existence, but was a wide valley similarly drained by a large river flowing to the west. The Bristol Channel was also a valley through which the Severn flowed to join a much larger stream draining the lake and plain of the present Irish Sea.

Now it is pretty certain that the first human immigrants came during this Pleistocene Age, if not earlier, and they certainly came by land. Along with the mammals from the south wandered the highest of them all; very low as yet in the scale of humanity, only a nomad hunter, but still a man, already asserting his dominion over the fowls of the air, the beasts of the field, and having within him, though undeveloped, all the infinite possibilities of our nature. Long before Great Britain was an island, man followed the chase up and down the valley of the Thames while that stream still paid tribute to the Rhine. He has left his flint weapons—knives and arrowheads—in no small numbers buried up in the gravel beds formed by the river on either side. "Innumerable horses," says Boyd Dawkins, "large heads of

stags, uri, and bison were to be seen in the open country, while the Irish elk and the roe were comparatively rare. Three kinds of rhinoceros, and two kinds of elephants lived in the forests. The hippopotamus haunted the banks of the Thames, as well as the beaver, the water rat, and the otter. There were wolves also, and foxes, brown bears and grisly bears, wild cats, and lions of enormous size." This was all the result of physical geography. And the primæval hunter followed them all.

It is worth while asking, What if things had remained so? How different might the course of history have run if the British area had continued to be merely an extension of Scandinavia to the west, and of France to the north, and no Channel or North Sea had ever been formed by the subsidence of the land! "There is no fact," says Professor Freeman, speaking of the original migration of the Angles or English people, "there is no fact in the whole history of our people more important than this, that our first settlement was made in an island. No migration to any other part of the continent could have had the same consequences as our migration from the continent to the isle of Great Britain. Our insular position determined our history, and determined our national character." "As for Ireland," says Mr. Scott Keltie, "her present troubles, which are also ours, are all due to St. George's Channel and her own bogs. Had Ireland and England been still as of yore, one continuous land, her conquest would have been begun long before it was, and would have been at least as complete as that of Wales and Scotland."

And, it may be added, the infusion of Teutonic blood in that Celtic island would have been far more complete; for the successive hordes of invaders would not have been checked by the sea. But, alas! St. George's Channel was formed, the separation was effected; hence the Irish question, hence also the Welsh question. Even our politics, you see, depend on geology.

Long ages afterwards, the Norsemen found the Shetlands and Orkneys very convenient stopping places; hence they found their way to Caithness and Sutherland (their southern land), but not much further. Why not?—Because the physical geography hindered them; all the country was covered with mountains, moor, and morass, and there was little inducement to cross them. Afterwards these same bogs and mountains played another important part in history. The men who penetrated into the Highlands by way of the east coast, or up from the south, made their way through the passes to the interior, and found there suitable retreats, in which they could, and did for a long time, defy the attacks of other tribes, and also the authority of the crown. Not only that, but the clans were able to isolate themselves within these natural boundaries, to keep separate and dis-

tant from each other, so tribal wars were prolonged, and the unity of the country hindered. In a similar way Professor Freeman says we may account for the isolation of the small states which occupied the Grecian peninsula. It was the absence of such massive and forbidding barriers in England which laid it more open to invasion, and to be more readily occupied, as the invaders were driven further west by new arrivals, and which afterwards made it more easy to reduce the whole country to obedience to one government—a task which was not really accomplished in Scotland until the close of the last century. I need not dwell on the obvious commercial advantages possessed by Great Britain in consequence of its severance from, and proximity to Europe,—the two "together, yet apart." Let me for a moment call your attention to the great advantage possessed by Ireland in early times in consequence of its isolation and sheltered position. Ireland was separated first, yet not before it had received human inhabitants; this was long before Britain was free from the continent; and the latter when it became an island, saved the former for many years from the evils which afflicted itself. While Saxon and Dane were harrying and conquering England along its eastern and southern shores, Ireland, protected as by a gigantic breakwater or line of defence, formed the home of religion and the resort of learning for all Europe; the asylum of persecuted monks and ardent students. Even earlier still, Mr. Justin H. McCarthy tells us, Ireland had made considerable progress in civilization, and was fairly prosperous, rearing sheep, cattle, pigs, and horses, and exporting metallic ore and slaves to the Mediterranean, being apparently in advance of the contemporary Britons. Christianity appears to have spread rapidly, and for a long time all Christendom looked upon Ireland as the favourite home of religion and wisdom." But such could not have been the case had Ireland preserved its land connection with Great Britain; it was all owing to geological action giving it its sheltered situation. Similar advantages were possessed by the small island of Iona off the west of Scotland.

But the vigorous onward progress of those terrible Norsemen brought them round to Ireland at last. In the eighth century they effected a settlement, murdered the clergy, and "drove out the Irish scholars to carry their culture and their philosophy" elsewhere. And these Norsemen, and this misfortune to Ireland, were the result of the effects of the physical geography of another country which had developed a race of such intrepid seamen and pirates.

The dependence of early English history on the nature of the country is well and clearly worked out by the late Mr. Green in his book on "The Making of England," and is the best example I know of the interweaving of the two subjects.

All the lowland districts of England at the time of the Roman

invasion, and to a slightly less extent at the end of their domination, were covered by either forests or swamps. The first areas settled by our own forefathers, the Saxons, were the lowlands along the coast, and the clearing on the higher ground, notably upon the Chalk Downs. Wood and marsh alike formed a barrier to the invading tribes. Hengist and Horsa followed the chalk uplands of the Caint, *i.e.*, what we now call Kent, shut in on the south and south-west by the great forest of Andredsweald, with its population of miners here and there in its recesses. This forest forbade advance westward, while south of the Roman fortress at Lympne lay Romney Marsh, as yet only partially drained. And so we find the next invasion was on the other side of the Weald forest and the Marsh, by the South Saxons, to whose boats the creeks and inlets which break the clay flats to the westward of the Arun offered an easy entrance.

Next came the East Saxons, who, keeping clear of the low marshes of South Essex, worked their way up the valleys of the Stour and the Colne. They were stopped by a great forest, reaching along the banks of the Roding, and so northward. We have a fragment of it in Epping Forest.

The Angles, who gave their name to our country, came in by the chalky uplands of Norfolk, and also along the Ware and Orwell. They were probably helped by the East Saxons. The fertility of this tract, known up to the present time as East Anglia, seems to have always attracted a large population, It was the seat of the Iceni, one of the most powerful as it was one of the most unfortunate of the British tribes, and it was also an important portion of the Roman dominion in Britain. It has been shown in a former lecture how this fertility is dependent on the admixture of formations and soils produced by glacial action.

The large area of the Wash and the Fens, which then reached from Cambridge and Newmarket northwards as far as Lincoln, forbade invasion in that direction, and the next was by way of the Humber, Lindsey in the north of Lincolnshire, and Holderness, in Yorkshire, being settled. And so on northwards. Time will not allow us to follow it all out. I must refer you to Mr. Green's own book. In the end, as you know, the Britons took refuge in the west, some worked their way northward through the present Lancashire, protected on their flank by the carboniferous range of the Pennine Hills. Others retreated among the Welsh mountains, where the physical geography of the district proved their protection and safety. Thus we find the most ancient people of Britain among the most ancient hills and rocks, in the district that had undergone the greatest amount of geological change. There they defied the English for many centuries, and were not conquered till the days of Edward I. Even now they are a separate people with

a separate language. They would not have been subdued when they were had St. George's Channel been still dry land. They would have fled across as others had done before them, followed doubtless sooner or later by their Saxon foes, in which case we should have had as strong an English element in Ireland as we have in the south of Scotland.

At the conclusion of the address the Chairman, in thanking Mr. Ullyett for his extremely interesting lecture, expressed a hope that someone would take up the opposite side of the question. Mr. Ullyett had shown them that the national character of a people was greatly influenced by the geology and geography of the country in which they dwell. He should like someone to read a paper showing the manner in which people maintained their national character despite geological and geographical changes.

Mr. Ullyett concurred. He hoped that someone would write a paper on the opposite side of the question for the May meeting. He would guarantee a discussion.

April 25th.

Microscopical Evening. Attendance small.

May 16th.

Microscopical Evening.

Mr. Walton also placed on the table, two plants in flower, new to the district :—*Trifolium maritimum* and *T. resupinatum*. Also *Cephalanthera, grandiflora, Orchis purpurea and Ophrys muscifera.*

Mr. Roberts brought a wild specimen of *Aquilegia vulgaris.* The Secretary exhibited a number of polished stones and pebbles.

October 3rd.

A collection of Autumn fruits was shown and described by Mr. Walton, and several other interesting objects were shown. The attendance was very fair.

NOVEMBER 7TH.

The following paper was read by Mr. F. Gell :—

MYTHICAL MONSTERS.

"In introducing a subject of so much interest, both from natural history and antiquarian points of view, it is perhaps better if we first enquire into the probable origin of the creatures as a whole, than to go into the details of the particular species which we shall have time to notice this evening. There seems to be no doubt from the fossil remains that have been discovered from time to time, of antediluvian animals, that our ancestors had considerable grounds to go upon if by chance they had met at any time with a solitary specimen of those frightful monsters prowling about. And indeed, prehistoric man himself, may have been familiar with the sight of these animals, which undoubtedly were of appalling proportions, and were provided with powers of destruction, which to-day, are rarely met with, except in a few cases; such for example as the elephant, the alligator, the boa constrictor, and rhinoceros, &c.

Now the mind of man is necessarily imaginative, it requires but a very small foundation of fact to raise up a tremendous superstructure of fiction upon, and where there are no facts at all, the mind easily conceives an ideal fact, as an imagined idea, which he thinks *ought* to be a fact, and he then builds up his superstructure upon that. Hence "castles in the air" passes into a proverb.

Don Quixote as we all know, sallied forth on his faithful steed "Rosinante," in order to slay giants and monsters of all kinds, which existed solely in his imagination. Primitive man hears a cry in the darkened forest at night;—it is a voice! it is a spirit! it is a form! it is a being!

So the evolution of thought goes on; to him it is a real being, to be feared because it may injure him, to be worshipped for the same reason, to be sacrified to since it needs must eat, and we have the voice of the forest resolved into a mythical monster, clothed with flesh, eyes to see, ears to hear, and talons perhaps to tear, and possessing abnormal powers of digestion.

The most curious observation with regard to the study of these beasts is, that they are in every case, a portraiture of the minds of those who thought them. Thus in Assyria, we have the gods altogether in harmony with the surroundings of that mighty nation, and the beast is built up precisely as assuredly no one but an Assyrian would do. In Greece it is the same, in Italy the same, in Africa the same, and in fact, everywhere the same.

Let me explain. Assyria was a great nation, an intelligent nation, and a learned nation, that fought great battles, and was in every sense, a carnivorous, fighting, and hunting nation. Now look at the Assyrian god. He has the head of a man, a fine intelligent head, full bearded and full browed, with fine eyes and a generally masterful expression. He has the body cf a lion, strength in every limb, force, and the carnivorous, flesh-eating, hunting instinct in every muscle. Lastly, he has the wings of an eagle, swiftness, a soaring power, a pouncing and seizing power, and the whole constitutes the main great central abstract ideal which was to be feared and worshipped, because it summed up in one monster, the hopes, aims, and aspirations, as well as the glory of the nation, which had no higher aims than these. And so the god was evolved, clothed with flesh, and became to them a real being. But the higher the race goes in civilization, the less it has to do with monsters. We find that after a period of time, the monsters depart and men take their place altogether, thus in Greece and Rome we find nearly all the star gods evolved into beautiful men and women, now and then with a faint trace of the beast as in Mercury for instance, with winged feet, emblematical of speed and swiftness of flight, as the Centaur with the body of a horse and the upper portion of a man as a head. To those people in those times, undoubtedly those legendary beings were real, and were believed in, just as much as people now-a-days believe in ghosts. Speaking of ghosts, goblins, etc., reminds me that a great effort is being made now-a-days, to raise *these* poor old played out mythical monsters into active work again. Just when the "Bogie Man" that came and snatched away little children had died a natural death, up he comes again as full of terror as ever. Mr. de Smythe, who never did anything in his life worth mentioning, is dragged from space to knock on a table or throw plates off a rack in the pantry; the curious part of it all, being that the people who are clothing these horrors of the imagination with flesh and making them appear as though they were real beings, are not gentlemen who run about in Central Africa, wearing a bead or two and a look of mild surprise, but men who have studied science and know all about the properties of matter, and therefore ought to known better.

There is one monster which is ever popular with us, will always be firmly believed in by one party and ridiculed by the other, and that regularly appears when Her Majesty's faithful Commons are not occupied in their arduous labours. I refer to the sea serpent. No sooner do I mention that enterprising and useful gentleman's name, than my audience is divided into two parties;—for and against. I have read authentic stories (says one perhaps in his mind), and I know it is true that there is such a

monster. Another will say perhaps, "*Yes*, it is true that it sells the papers, and it is a curious fact, that all through the summer, we haven't heard of him once, for the simple reason that the Home Rule Bill has kept him away."

Well, gentlemen, you can of course enjoy your various opinions; personally, I shall "sit upon the fence," as the Americans say, and observe that I don't know what to believe. However, it is generally conceded that he is about a quarter of a mile in length, that he has jaws capable of swallowing one of our little fishing crafts, and that he is about as thick round the body as the mast of a man-of-war. All accounts vary in details however, as to the colour of his hair, the number of his teeth, and as to the remarks he makes on his appearing. Some say he roars and bellows, others not; and in fact there are so many different versions as to his personality, that I think we may well dismiss him from our minds, marked, as an eminent lawyer used to mark some of his briefs, with a large D.C., which being interpreted, meant "Doubtful Case."

We next have to deal with a myth, which can scarcely be called a monster, inasmuch as it is of the gentler sex, and although ladies are privileged to call the male *genus homo* a monster, when she doesn't happen to precisely attain the object for which she has planned (say a sealskin jacket for instance), yet the aforesaid *genus homo* must reply in very *homœopathic* doses of verbiage. Pardon me for this digression, but really when approaching ladies as the gentleman said to the bear, "you do have to be so very particular."

Well then, this lady is a mermaid, and her origin is shrouded in considerable obscurity. Of a fair and delightful complexion, with golden hair and azure eyes, with a soft cooing voice and a languishing look, she sits upon a rock, gazing into her mirror, combing her locks the while, and drawing imprudent mariners to a closer inspection. Alas! they do not perceive the scaly, horrible coils of the lower half of her body. Fish like, and yet snake like, it moves to and fro in the water, much as a cat does when watching for a mouse. Nearer and nearer draws the ill-fated barque, crash goes her stout stern post on the hidden rock, and the sea siren with a shrill note of triumph, seizes her prey, dragging down the unfortunate mariners to a deathly bridal chamber in the cool green recesses of the sea-washed caves on the floor of the ocean bed.

It is asserted that the dugong or the seal may have lent considerable colour to the mermaid myth, its flippers being somewhat like hands, and the tail being of the necessary shape and colour. Its head also is very human-like in appearance, the eyes soft and gentle, and its whole appearance tending to give sufficient basis

for the truthful explorer to build up his imaginative superstructure upon. It is however, far more likely that the mermaid was evolved from a fish god or demon, and worshipped by primitive races of sea-going men, in order to be defended from the perils and dangers of the treacherous element upon which they had to gain their livelihood

Sailors who believe in mermaids—if there are still any, that cherish the delighful old superstition—are not likely to think of tracing their belief back to the Assyrians and Egyptians; but antiquaries are willing to do so for them. In a cold blooded way the footsteps of tradition are traced backwards, till even the beautiful fair-haired mermaid of ballad and legend is proved to be a descendant of the Philistine Dagon. One would have thought her more akin to Delilah, but the facts are against us.

"Dagon his name; sea-monster, upward man and downward fish."

Hieroglyphics and carvings teach us that such sea-monsters were by no means uncommon deities in those times. Probably the idea of a divinity who presided equally over the land and over the sea first suggested the myth. The Greeks, who beautified everything they touched though they did not always add to its dignity, played with this idea in many forms. As a rule, their love of beauty led them to reject the fishy extremity; their Oceanides, Nereids, and Naiads, are usually represented as lovely women. Sometimes, it is true, the tail takes the place of the feet; and with Triton this is always the case. It is Triton through whose "wreathed horn" the voice of the sea speaks. The Sirens, originally a species of harpy, afterwards developed into mermaids, and it is unquestionable that personal beauty was a part of their charm. The famed Scylla was a semi-human sea-monster—transformed into such, it is said, by the jealousy of Circe. We can trace similar fancies in the traditions of every land under the sun. They follow us into Mexico and Peru, Canada, Japan, India, Norway, Ireland. The Irish national emblem is a harp, one side of which is the bust of a woman; and Moore has given a poetical rendering to the tradition of its origin.

Mr. Miller says that myths were originally a number of *terms* for abstract ideas, which, in early ages could not be expressed. As long as people *thought* it was necessary in the language of primitive times to associate with such words as dawn, day, night, earth, etc., some *being* (beneficent or otherwise), we then see that the basis of these myths (which are just as much a part of early conjectural science as of early religion), is naturally the *experience* of the savage, as construed by himself. Man's craving to know the "reason why," is among the rude savages just as

much an intellectual appetite as it is with us. How does he try to satisfy this craving? Mr. Tylor, another authority on these vastly interesting enquiries replies:—"When the attention of a man in the myth-making stage of intellect"—(a delightful phrase that)—"is drawn to any phenomenon or custom, which has to him no obvious reason, he invents a story to account for it."

We now know how it is that savages come to have a mythology. It is their way of satisfying the early form of scientific curiosity, and their way of realizing the world in which they move. But they frame their stories, necessarily and naturally, in harmony with the general theory of things, with what we may call "savage metaphysics. But to the savage and apparently to peoples more backward than the most backward peoples of which we know, all nature was a series of animated personalities.

Thus the Bushmen say the wind was formerly a person, and it is a tradition among them that he was once seen. The Egyptians, according to Herodotus, believed fire to be a live beast.

The Piute Indians have this legend: The sun is the father and ruler of the heavens. He is the big chief. The moon is his wife, and the stars are their children. The sun eats his children whenever he can catch them. They flee before him, and are all the time afraid when he is passing through the heavens. When he (their father) appears in the morning you see all the stars, his children, fly out of sight, go away back into the blue of the above, and they do not wake to be seen again until he (their father) is about going to his bed.

Down deep under the earth—deep, deep under the ground—is a great hole. At night, when he has passed over the world, looked down on everything, and finished his work he, the sun, goes into his hole, and he crawls and creeps along till he comes to his bed in the middle part of the earth. So then he, the sun, sleeps there in his bed all night.

This hole is so little, and he, the sun, is so big, that he cannot turn round in it, and so he must, when he has had his sleep, pass on through, and in the morning we see him come out in the east. When he, the sun, has come out he begins to hunt up through the sky to catch and eat any that he can of the stars, his children; for if he does not so catch and eat he cannot live. He, the sun, is not all seen. The shape of him is like a snake or a lizard. It is not his head that we see, but his belly, filled up with the stars that times and times he has swallowed.

The moon is the mother of the heavens, and is the wife of the sun. She, the moon, goes into the same hole as her husband to sleep her naps. But always she has great fear of the sun her husband, and when he comes through the hole to the nobee (tent)

deep in the ground, to sleep, she gets out and comes away if he be cross or irritated.

She, the moon, has great love for her children, the stars, and is, happy to travel among them in the above; and they, her children, feel safe and sing and dance as she passes along. But the mother, she cannot help that some of her children must be swallowed by the father every month. It is ordered that way by Pah-ah (Great Spirit), who lives above the place of all.

Every month that father, the sun, does swallow up some of the stars, his children, and then that mother, the moon, feels sorrow. She must mourn. So she must put the black on her face for to mourn the dead. You see the Piute women put black on their faces when a child is gone. But the dark will wear away from the face of that mother, the moon—a little and a little every day—and after a time again we see all bright the face of her. But soon more of her children are gone, and again she must put on her face the pitch and the black.

We will now pass by an easy transition to another more dangerous monster, viz: "The Dragon." Its name is lost in considerable obscurity, but we know it to be of the lizard family, with a touch of the serpent about the tail. It was certainly a fearsome beast, inasmuch as in its internal economy, it possessed the power of vomiting forth fire and smoke and was worthy of the noblest efforts of the gods and heroes of heathen mythology. Thus a dragon watched the garden of the Hesperides, and its destruction formed one of the seven labours of Hercules. Its existence does not seem even to have been called in question by the older naturalists (says the Ency. Britt.) figures of the dragon, appearing in the works of Gesner, and even specimens of the monster (evidently formed of portions of various animals), have been exhibited. The only creature ever known to have existed at all, comparable to this imaginary monster, are the Pterodactyls remains of which have been found in the Liassic and Oolitic formation. These were huge reptiles, provided with true wings, somewhat resembling those of bats. It will be remembered that the dragon plays a great part in the Heraldic History of England, and occupies a prominent place on the largest of our silver coins, where he is doing his best to look pleasant under the horse's hoofs of the mighty St. George the patron saint of "Merrie England."

St. George, I believe, still forms a degree of honour among the knights of to-day, and there is a cross of St. George with dragon and all presented to those who may by their merits be deemed worthy of its reception. St. Michael also slays a dragon, as we read in Revelations, and in the great East Window of St. Michael's Church there is a very artistic representation of the encounter.

Folkestone has a fiery serpent all to itself among its folk lore, and this also partakes of the nature of a dragon, at all events by report, and yet there are people bold enough to assert that such reptiles were never seen.

THE DRAGON.

In the birthtime of the dragon-myth, the primitive Aryan, suffering under the manifold ills of life, attributed them all, we cannot doubt, to the operation of a malevolence not unlike to his own, and sought a shape—*monstrum, horrendum, informe, ingens*—in which they should be abhorred, and, it might be, slain. He projected his own personality into the operations of nature, of which he felt himself to be the plaything; and gave, as Shelley phrases it," "a human heart to what we cannot know." In the cloudy strongholds of darkness his enemy was sheltered, a monstrous shape, "if shape it might be called that shape had none," from whose terrors he suffered most cruelly when the drought came, and famine and pestilence were spread abroad through the plains. This is no mere poetical view of the matter for in the Veda the earliest presentation of the enemy of Aryan man is Vritra or Ahi, the throttling snake, who is not only the universal enemy, but is also in a special manner the chief, and the black with-holder of the rain; and conversely, Indra himself, the sustainer of the universe, the wonder worker and the old guide of man, is in special degree the light maker and rain bringer. Everywhere in the Veda the elemental conflict between these two goes on. Indra, youthful, agile, ruddy, and strong, goes forth in his chariot, the thunderbolt forged by Tvashtri in his hand, his steeds snorting and neighing, to battle with Ahi or Vritra, the enemy. He is accompanied by clouds of Maruts, and the whole artillery of heaven is discharged; the earth and the sky crash with his thunderbolt, the cloud castles of the monster are shattered and broken, the celestial fountains are loosed, and the rain flows plenteously on the earth below.

To the Chinese and Japanese belongs the credit of having conceived the dragon in the most terrific shape that has ever been given to it; and it would probably be impossible to express in animal form greater fierceness and malignity than are depicted in the emblem of Chinese royalty. It is also in China that the dragon reaches the highest pinnacle as an object of reverence; for not only is it emblazoned on imperial standards and figured in almost every prominent position as a decoration, but it is markedly an object of propitiation, and festivals are held in its honour. Yet its connection with the root idea of the Hindoos is never lost, for it is a monster of mists and waters, and is painted issuing from clouds. Ling Wong, the dragon king, has in his keeping the foundations of

the deeps, and from him are the rains derived. There is evidence also of human sacrifice to the monster, for Hiouen-Thsang (the Chinese Buddhist pilgrim to India, seventh century A.D.) relates how that one Wat Yuen, on the failure of a river immolated himself in propitiation of its dragon; and at the dragon boat festivals it is now believed that the boats intimidate the monster. Such ideas were probably carried to China and Japan with Buddhism (and perhaps there engrafted on national myths), for Buddha himself was a dragon slayer, and there is much in Hiouen-Thsang throwing light upon the subject. It is possible very clearly to trace the dragon of Japan as a creature of marsh and slime, to which propitiation was made; and it may be of interest to mention that a fairy story is now being sold in Tokio, entitled "Yamata no Orochi," in which an eight headed monster is appeased, much as in the chivalric myth, by the sacrifice of maidens.

We will now if you please take a glance at another monster also very much akin to the dragon, that is the noble beast which strikes the visitor to London, with such awe not unmingled with astonishment. I refer to the griffin. The griffin or *gryphon* in the natural history of the ancients, is the name of an imaginary rapacious creature of the eagle species, represented with four legs, wings, and a beak, the fore part resembling an eagle, and the hinder, a lion. In addition, some writers describe him as having the tail of a serpent,—(the trail of the serpent is over them all). I was vastly amused when looking up the authorities on these matters, to find what a deal of description was always devoted to the tail. Well, the griffin is supposed to watch over gold mines and hidden treasures, and to be the enemy of the horse, (*why*, the historians do not say. He was consecrated to the sun, and the ancient painters represented the chariot of the sun as drawn by griffins. According to Spanheim, Jupiter and Nemesis were similarly provided. The griffin of the scriptures is probably that species of eagle called the osprey. The griffin is related to inhabit Asiatic Scythia, where the lands abound in gold and precious stones, and when strangers approach to gather these spoils, the griffins leap upon the adventurers and tear them in pieces, "thus chastising human avarice and greed" as the historian quaintly remarks, forgetting that the griffins are very avaricious themselves, or they would not mind allowing others to share that which could be of no possible use to them. However, to resume, the griffin has like the rest of these monsters, been seen by mortal eyes, and the celebrated Sir John de Mandeville in his "travels" described one he met with eight times larger than a lion. However, be that as it may, and as geography is described as the science by which you learn about foreign countries from people who have never been there, so I may describe monsters that I

have never seen, but have to take the word of others for it. The griffin, as you all know, plays a prominent part in the heraldry of the City of London, and also by some occult process of reasoning, does he visit the Post Office, and if you have not already observed him, the next time you pass up the Sandgate Road, if you take a look at the top of the General Post Office you will find him perched up aloft, guarding the treasures in the safes below. We now will, if you please, just glance at another mythical monster, the existence of which was firmly believed in throughout ancient and mediæval times. I mean the cockatrice also mentioned in scripture as having a "den." Descriptions and figures of it appear in the natural history works of such writers as Pliny, published so late as the beginning of the 17th century. Produced from a cock's egg and hatched by a serpent, it was believed to possess the most deadly powers. Plants withered at its touch, and men and animals died poisoned by its look. It stood in awe however, of the crowings of the cock, the sound of whose crowing killed it; consequently, travellers were wont to take this bird with them when travelling through districts supposed to be infested by these monsters. What would happen however, should the cock refuse to crow at the critical moment history is silent upon. The weasel alone among the mammals was unaffected by the glance of its evil eye, and attacked the monster, it is said, often with signal success, for when wounded by the monster's teeth, it found a ready remedy in rue, the only plant the cockatrice could not wither.

The next monster that we have to encounter is the "Basilisk." Very little appears to be known about the basilisk; which, however, should find a place in this paper, as it comes under the heading of our discourse this evening. "It was a horrid monster," say the authorities on the subject, "of the most demoniacal powers and of equally demoniacal appearance." The term is now used to describe a genus of lizards, which are characterized by a membranous bag on the crown of the head which they can distend or contract at will; they also possess a fin-like ridge along the back part of the tail.

I shall bring this paper to a conclusion by giving a little information about our old heraldic friend the "Unicorn," about which animal there might, as you may well imagine, whole volumes be written:

The myth appears to have originated with the rhinoceros, though how any person can reconcile the two ideas, is rather difficult to imagine. It should have the body of a horse, with a long spirally twisted horn projecting from the forehead, like that of the narwhal. The belief in the existence of the animal is very ancient, dating back to Aristotle; the Bible also mentions the unicorn, although probably it is a mistranslation for antelope. However, be that as it may, whether antelope or rhinoceros, it

was evidently an animal to be feared and by no means to be taken without considerable danger. There is a tremendous amount of literature concerning his adventures and his history, which, at all events, I will not trouble you with to-night, only remarking that he may think himself highly honoured to live in an age, where we consider him of sufficient importance to be a supporter of the British Crown.

A short discussion ensued, after which a vote of thanks was accorded to Mr. Gell; the Rev. W. Hall complimenting him on this, his first essay, before the Society.

Tuesday, December 19th.

The annual meeting was called for this evening, but owing to the small number present (the weather being very tempestuous), and to the absence of the Secretary, through illness, it was thought advisable to postpone the usual business until January. The report will, therefore, be found in next year's "Proceedings."

Notes on the Weather for 1893.

Kindly drawn up by Mr. J. Stainer.

The following is the Monthly Rainfall.

January	...1·73 inches	July	.........3·26 inches
February	...4·10 ,,	August	......1·25 ,,
March	......0·63 ,,	September	...5·06 ,,
April	.........0·00 ,,	October	......5·02 ,,
May	.........0·91 ,,	November	...4·61 ,,
June	.........0·72 ,,	December	...2·22 ,,

For the year 29.50.

METEOROLOGY, 1893.

The weather of 1893 was in some respects unique. If the paradox may be allowed, *it always is.* Such is the delightful uncertainty of the English climate that it is sure to beat the record at some point during the twelve months. It will be either warmer or colder in January than it ever was before since trustworthy records have been kept. Or it will be wetter or drier in February than it was in the past. Or March will be abnormally still when strong winds ought to blow, and perhaps we have to make fires to warm our rooms in June because of the cold, and put them out in Decem-

ber because of the heat, and at some point or other the unexpected is sure to happen. What an opening there is for a trustworthy weather prophet. Dr. Falbe tried his hand last year and was a dismal failure. No one seems to be able to look forward with any confidence for more than 36 hours at the outside. Who, for instance, knew beforehand that we should have about 4½ inches of rain here last February, and that that coupled with the excessive wet of several previous months would cause the land to slip at Sandgate? Nobody. At least if any one did he ought to be punished for not speaking of it. Or who could have told us that Summer would begin about the 1st of March, and continue till the last day of October, and that there would be no rain at all in April, and next to none in either March or May. Or that we should have to speak of June as a rainless month? This we now know was the case, but if we could have known beforehand, what valuable information it would have been. Fortunately the lack of moisture did not hurt Folkestone particularly, and it was not necessary to put us on short commons for a moment in the matter of our water supply. However, the deficiency was made up in the last four months of the year. The rain of September and October was splendid, benefitting all and hurting nobody, as most of it fell in the night.

I began by referring to the delightfully uncertain condition of things meteorological here, and I mean what I say. Depend upon it the perpetual variations in our climate do us good and not harm. Else why do we live longer in England than any other country? It is well known that we do, and that we live rather longer in Folkestone than in almost any other place.

LIST OF SOCIETIES

WITH WHICH "PROCEEDINGS ARE EXCHANGED."

The Scientific Association, Meriden, Conn., U.S.
The Academy of Sciences, New York.
The Academy of Sciences, Philadelphia
The Elliott Society of Science and Arts, Charlestown.
The Rochester Academy of Science, Rochester, N.Y.
The Imperial German Academy, Halle-on-the-Saale.
The Tunbridge Wells Natural History Society.
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The East Kent Natural History Society.
The Brighton and Sussex Natural Histcry Society.
The Eastbourne Natural History Society.

The Harrogate Natural and Scientific Society.
The Geological Society, Glasgow.
The Philosophical Society, Glasgow.
The Manchester Microscopical Society.
Societé Scientifique du Chili.
Their publications can be seen on application to the Secretary.

Officers and Rules

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RULES.

1.—That the Society shall be called "THE FOLKESTONE NATURAL HISTORY AND MICROSCOPICAL SOCIETY," and its objects shall be to work out the Natural History of the locality, to promote the study of all branches of Natural History, and to facilitate mutual assistance between its members in such study.

2.—The affairs of the Society shall be managed and administered by a President, four Vice-Presidents, an Honorary Secretary and Treasurer, and a Committee of six Members. Three shall form a quorum.

3.—The Officers and Committee shall be elected annually at a General Meeting, to be held as provided in Rule 8. A list of nominees shall be prepared by the Committee, and submitted to such Annual Meeting, and the election shall then be taken by show of hands. Any vacancy which may occur during the interval between two Annual Meetings shall be filled in by the Committee, and reported to the Society at the next meeting.

4.—All persons above sixteen years of age are eligible as members. Anyone desiring to join the Society must be proposed and seconded by two members at any ordinary meeting, and may then be elected by show of hands.

5.—All members shall contribute a Subscription of Five Shillings annually, payable on election, and on each succeeding first of January. Members elected in December shall not be liable for any subscription until the following first of January.

6.—An ordinary Meeting of the Society for the election of Members, for reading and discussing papers and correspondence, and for the exhibition of Microscopical and other specimens, shall be held on the first Tuesday in each month at the Museum at 8.15 p.m.; or at any other time and place duly notified to the members.

7.—Each member may introduce two friends at any ordinary meeting.

8.—An Annual General Meeting of the Society for the election of Officers and Committee, for receiving and considering the statement of accounts and a report of the Committee on the affairs of the Society, for alteration of Rules, and for other business, shall be held in January. Six members shall form a quorum at such meeting.

9.—In the event of its becoming necessary in the interval between two Annual General Meetings to consider any proposed alteration in the Rules, or other matter of special importance, such question may be considered and settled at an ordinary Meeting of the Society, provided that notice thereof has been given to the members.

10.—The Committee may at its discretion make grants of money from its available funds towards paying the expense of illustrating lectures and for the purchase of books on Natural History and Microscopy.

Persons wishing to beecome Members should apply to the Secretary.

LIST OF BOOKS

Belonging to the Library of the

Folkestone Natural History and Microscopical Society

Micrographic Dictionary. By J. W. Griffith and A. Henfrey. 1883.
Forms of Animal Life. By Prof. G. Rolleston. 1888.
Smithsonian Report—United States National Museum. 1889.
Practical Microscopy. By G. E. Davis. 1889.
Life Histories of North American Birds. By Capt. C. Bendire. 1892
Manual of Marine Zoology of the British Isles. By P. H. Gosse—2 vols. 1855-6

History of British Hydroid Zoophytes. By Rev. T. Hincks—2 vols. 1868.
History of British Sea Anemones and Corals. By P. H. Gosse. 1860.
History of British Starfishes and other Echinodermata. By Prof. E. Forbes. 1841.
History of British Marine Polyzoa. By Rev. T. Hincks—2 vols. 1882.
The Year Book of Science for 1892. Published by Cassell and Co 1893.
The Year Book of Scientific and Learned Societies for 1893 Published by Griffin and Co.
The Aquarium. By P. H. Gosse.

RULES OF THE LENDING LIBRARY.

1.—The books shall be in the custody of Mr. S. Hills, Public Librarian.

2.—Members may obtain any work among them on loan on application to Mr. Hills at such times as the Public Lending Library is open.

3.—Only one work may be taken out at a time by any member.

4.—Each book may be kept seven days, but may be renewed at the end of that time if no other member has applied for it.

5.—A fine of one penny must be paid for each week that a book has been retained without a formal renewal of the same.

6.—All damage beyond ordinary wear must be made good by the borrower.

N.B.—It must be understood that on the evenings of the Society's meetings ALL books out on loan shall be brought and placed on the table; but they may be taken away again at the conclusion of the meeting.

Hy. ULLYETT, Hon. Sec.

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,, sceleratus
,, Flammula
,, auricomus
,, acris
,, repens
,, bulbosus
,, Sardous
,, arvensis
,, Ficaria
Caltha palustris
Helleborus viridis
Aquilegia vulgaris

BERBERIDEÆ.

Berberis vulgaris

PAPAVERACEÆ.

Papaver *somniferum*
,, Rhœas
,, dubium
,, argemone
,, hybridum
Glaucium flavum
Chelidonium majus

FUMARIACEÆ.

Corydalis *lutea*
,, claviculata
Fumaria officinalis
,, parviflora

CRUCIFERÆ.

Cheiranthus Cheiri
Nasturtium officinale
Barbarea vulgaris
Cardamine pratensis
,, hirsuta

CRUCIFERÆ (Continued)

Alyssum *incanum*
,, *maritimum*
Erophila vulgaris
Sisymbrium Thaliana
,, officinale
,, alliaria
Brassica oleracea
,, nigra
,, Sinapis
,, alba
Diplotaxis tenuifolia
,, muralis
Capsella Bursa-pastoris
Senebiera Coronopus
Lepidium ruderale
,, campestre
,, Smithii
,, Draba
Crambe maritima
Cakile maritima
Raphanus Raphanistrum

RESEDACEÆ.

Reseda-lutea
,, Luteola

CISTINEÆ.

Helianthemum Chamæcistus

VIOLARIEÆ.

Viola odorata
,, b alba
,, hirta
,, sylvatica
,, Reichenbachiana
,, canina
,, tricolor
,, arvensis

POLYGALEÆ.

Polygala vulgaris

FRANKENIACEÆ.

Frankenia lævis

CARYOPHYLLEÆ.

Dianthus Aremeria
Saponaria officinalis
Silene Cucubalus
,, maritima
,, gallica
,, c. anglico x quinquevulnera
,, nutans
,, noctiflora
Lychnis alba
,, diurna
,, Flos-cuculi
,, Githago
Cerastium quaternellum
,, tetrandrum
,, semidecandrum
,, glomeratum
,, triviale
,, arvense
Stellaria media
,, Holostea
,, graminea
,, uliginosa
Arenaria trinervis
,, serpyllifolia
,, peploides
Sagina maritima
,, apetala
,, procumbens
,, nodosa
Spergula arvensis
Lepigonum rubrum
,, salinum
,, marginatum

PORTULACEÆ.

Montia fontana

TAMARISCINEÆ.

Tamarix gallica

HYPERICINEÆ.

Hypericum Androsœmum
,, *hircinum*

HYPERICINEÆ (Continued)

Hypericum perforatum
,, quadratum
,, humifusum
,, pulchrum
,, hirsutum
,, elodes

MALVACEÆ.

Althæa officinalis
Lavatera arborea
Malva moschata
,, sylvestris
,, rotundifolia

TILIACEÆ.

Tilia *vulgaris*

LINEÆ.

Linum catharticum
,, angustifolium
,, usitatissimum

GERANIACEŒ.

Geranium *striatum*
,, pratense
,, pyrenaicum
,, molle
,, pusillum
,, dissectum
,, columbinum
,, Robertianum
Erodium cicutarium
Oxalis Acetosella

ILICINEÆ.

Ilex aquifolium

CELASTRINEÆ.

Euonymus europæus

RHAMNEÆ.

Rhamnus catharticus
,, Frangula

SAPINDACEÆ.

Acer *Pseudo-platanus*
,, campestre

LEGUMINOSÆ.

Genista angtica
,, tinctoria
Ulex europæus
Cytisus scoparius
Ononis repens
,, spinosa
Trigonella purpurascens
Medicago sativa
,, lupulina
,, denticulata
,, maculata
,, minima
Melilotus altissima
,, *officinalis*
Trifolium subterraneum
,, pratense
,, medium
,, maritimum
,, *incarnatum*
,, arvense
,, striatum
,, scabrum
,, *glomeratum*
,, *hybridum*
,, repens
,, fragiferum
,, *resupinatum*
,, agrarium
,, procumbens
,, filiforme
Anthyllis Vulneraria
Lotus corniculatus
,, pilosus
Ornithopus perpusillus
,, ebractealus
Hippccrepis comosa
Onobrychis sativa
Vicia hirsuta
,, tetrasperma
,, Cracca

LEGUMINOSÆ (Continued)

Vicia sylvatica
,, sepium
,, sativa
,, angustifolia
b Bobartii
,, lathyroides
,, bithynica
Lathyrus aphaca
,, Nissolia
,, pratensis
,, *latifolius*
,, sylvestris
,, macrorrhizus

ROSACEÆ.

Prunus communis
,, avium
Spiræa Ulmaria
,, Filipendula
Rubus fruticosus (several forms or sub-species, including Rubus cæsius, the Dewberry)
Geum urbanum
Fragaria vesca
Potentilla Fragariastrum
,, Tormentilla
,, reptans
,, anserina
,, argentea
Alchemilla arvensis
Agrimonia Eupatoria
Poterium Sanguisorba
Rosa spinosissima
,, rubiginosa
,, canina (several varieties)
Pyrus aria
,, aucuparia
,, malus
Cratægus Oxyacantha

SAXIFRAGEÆ.

Saxifraga tridactylites
Chrysosplenium oppositifolium
Ribes *Grossularia*
,, rubrum

CRASSULACEÆ.

Sedum Telephium
,, anglicum
,, acre

DROSERACEÆ.

Drosera rotundifolia

HALORAGEÆ.

Hippuris vulgaris
Myriophyllum spicatum
Callitriche vernalis
,, stagnalis
,, hamulata

LYTHRARIEÆ.

Lythrum Salicaria
Peplis Portula

ONAGRARIEÆ.

Epilobium angustifolium
,, hirsutum
,, parviflorum
,, montanum
Circæa lutetiana

CUCURBITACEÆ.

Bryonia dioica

UMBELLIFERÆ.

Hydrocotyle vulgaris
Eryngium maritimum
,, campestre
Sanicula europæa
Conium maculatum
Smyrnium Olusatrum
Bupleurum tenuissimum
Apium graveolens
,, nodiflorum
Carum segetum
Sison Amomum
Sium angustifolium
Pimpinella Saxifraga
,, major
Conopodium denudatum

UMBELLIFERÆ (Continued)

Chærophyllum temulum
Scandix Pecten-Veneris
Anthriscus vulgaris
,, sylvestris
,, *Cerefolium*
Fæniculum officinale
Crithmum maritimum
Ænanthe fistulosa
,, Lachenalii
,, crocata
,, Phellandrium
Athusa Cynapium
Silaus pratensis
Angelica sylvestris
Peucedanum sativum
Heracleum Sphondylium
Daucus Carota
,, gummifer
Caucalis anthriscus
,, nodosa

ARALIACEÆ.

Hedera Helix

CORNACEÆ.

Cornus sanguinea

CAPRIFOLIACEÆ.

Adoxa moschatellina
Sambucus nigra
,, Ebulus
Viburnum opulus
,, Lantana
Lonicera Periclymenum
,, *Xylosteum*

RUBIACEÆ.

Rubia peregrina
Galium Cruciatum
,, verum
,, mollugo
,, Saxatile
,, palustre
,, uliginosum

RUBIACEÆ (Continued)

Galium Aparine
,, tricorne
Asperula odorata
,, cynanchica
Sherardia arvensis

VALERIANEÆ.

Valeriana dioica
,, officinalis
Centranthus ruber
Valerianella olitoria

DIPSACEÆ.

Dipsacus sylvestris
Scabiosa succisa
,, Columbaria
,, arvensis

COMPOSITÆ.

Eupatorium cannabinum
Solidago Virgaurea
Bellis perennis
Aster Tripolium
Erigeron acre
Filago germanica
,, minima
Gnaphalium uliginosum
,, sylvaticum
Inula Conyza
Pulicaria dysenterica
Achillea millefolium
Anthemis cotula
,, arvensis
Chrysanthemum Segetum
,, Leucanthemum
Matricaria inodora
,, Chamomilla
Tanacetum vulgare
Artemisia vulgaris
,, maritima
Tussilago Farfara
Petasites vulgaris
Senecio vulgaris
,, sylvaticus

COMPOSITÆ (Continued)

Senecia viscosus
,, crucifolius
,, Jacobæa
,, aquaticus
Carlina vulgaris
Arctium minus
Cardicus pycnocephalus
,, nutans
,, crispus
Cnicus lanceolatus
,, criophorus
,, palustris
,, acaulis
,, arvensis
Centaurea nigra
,, scabiosa
,, Cyanus
,, Calcitrapa
,, *solstitialis*
Cichorium Intybus
Lapsana communis
Picris hieracioides
,, echioides
Crepis taraxacifolia
,, virens
,, biennis
Hieracium Pilosella
,, umbellatum
,, boreale
Hypochæris radicata
Leontodon hirtus
,, hispidus
,, autumnalis
Taraxacum officinale
Lactuca virosa
,, muralis
Sonchus oleraceus
,, arvensis
Tragopogon pratensis

CAMPANULACEÆ.

Jasione montana
Campula Trachelium
,, rotundifolia
Specularia hybrida

ERICACEÆ.

Calluna Erica
Erica Tetralix
,, cinerea
Pyrola media

MONOTROPEÆ.

Hypopithys multiflora

PLUMBAGINEÆ.

Statice Limonium
Armeria maritima

PRIMULACEÆ.

Primula vulgaris
c. caulesceus
,, veris
Lysimachia vulgaris
,, nummularia
,, nemorum
Glaux maritima
Anagallis arvensis
,, cærulea
,, tenella
Samolus Valerandi

OLEACEÆ.

Fraxinus excelsior
Ligustrum vulgare

APOCYNACEÆ.

Vinca minor

GENTIANEÆ.

Blackstonia perfoliata
Erythræa Centaurium
Gentiana Amarella
Menyanthes trifoliata

BORAGINEÆ.

Cynoglossum officinale
Symphytum officinale
Borago officinale
Borago officinalis
Lycopsis arvensis

BORAGINEÆ (Continued.)

Myosotis cæspitosa
,, palustris
,, repens
,, arvensis
,, collina
,, versicolor
Lithospermum arvensis
Echium vulgare

CONVOLVULACEÆ.

Calystegia Sepium
,, Soldanella
Convolvulus arvensis
Cuscuta Epithymum
,, *Trifolii*

SOLANACEÆ.

Solanum Dulcamara
,, nigrum
Lycium barbarum
Datura Stramonium
Hyoscyamus niger

SCROPHULARINEÆ.

Verbascum Thapsus
,, nigrum
Linaria *Cymbalaria*
,, Elatine
,, spuria
,, vulgaris
,, viscida
Scrophularia aquatica
,, nodosa
Mimulus lutens
Digitalis purpurea
Veronica hederæfolia
,, agrestis
,, persica
,, arvensis
,, serpyllifolia
,, officinalis
,, Chamœdrys
,, montana
,, Scutellata

SCROPHULARINEÆ (Contd.)

Veronica Anagallis
,, Beccabunga
Euphrasia officinalis
Bartsia Odontites
Pedicularis sylvatica
Melampyrum pratense
Rhinanthus Crista.galli

OROBANCHACEÆ.

Orobanche major
,, caryophyllacea
,, Picridis
,, amethystea
Lathræa Squamaria

VERBENACEÆ.

Verbena officinalis

LABIATÆ.

Mentha sylvestris
,, hirsuta
,, arvensis
Lycopus europæus
Origanum vulgare
Thymus Serpyllum
Calamintha Clinopodium
,, arvensis
,, officinalis
Salvia Verbenaca
Nepeta Cataria
,, Glechoma
Scutellaria galericulata
,, minor
Prunella vulgaris
Marrubium vulgare
Stachys Betonica
,, palustris
,, sylvatica
,, arvensis
Galeopsis Ladanum
,, Tetrabit
Lamium amplexicaule
,, purpureum
,, album

LABIATÆ Continued.

Lalium Galeobdolon
Ballota nigra
Teucrium Scorodonia
Ajuga reptans

PLANTAGINEÆ.

Plantago major
,, media
,, lanceolata
,, Coronopus

ILLECEBRACEÆ.

Scleranthus annuus

CHENOPODIACEÆ.

Chenopodium polyspermum
,, vulvaria
,, album
,, murale
,, Bonus-Henricus
Beta maritima
Atriplex littoralis
,, patula
,, hastata
,, Babingtonii
,, portulacoides
Salicornea herbacea
Suæda maritima

POLYGONACEÆ.

Polygonum Convolvulus
,, aviculare
,, Hydropiper
,, Persicaria
Rumex conglomeratus
,, Sanguineus
,, pulcher
,, obtusifolius
,, crispus
,, Hydrolapathum
,, acetosa
,, acctosella

THYMELÆACEÆ.

Daphne Laureola

ELÆAGNACEÆ.

Hippophae rhamnoides

EUPHORBIACEÆ.

Euphorbia Helioscopia
,, amygdaloides
,, Peplus
,, exigua
Buxus sempervirens
Mercurialis perennis
,, annua

URTICACEÆ.

Ulmus montana
,, campestris
Humulus Lupulus
Urtica dioica
,, urens
Parietaria officinalis

CUPULIFERÆ.

Betula alba
Alnus glutinosa
Carpinus Betulus
Corylus avellana
Quercus Robur
Castanea *sativa*
Fagus sylvatica

SALICINEÆ.

Salix tracilis
,, alba
,, viminalis
,, Caprea
Populus alba
,, tremula
,, *nigra*

CERATOPHYLLEÆ.

Ceratophyllum demersum

CONIFERÆ.

Juniperus communis
Taxus baccata
Pinus sylvestris
Pinaster

HYDROCHARIDEÆ.

Hydrocharis morsus-rana

ORCHIDEÆ.

Neottia nidus-avis
Listera ovata
Spiranthes autumnalis
Cephalanthera pallens
Epipactis latifolia
Orchis pyramidalis
,, ustulata
,, purpurea
,, morio
,, mascula
,, latifolia
,, maculata
Aceras anthropophora
Ophrys apifera
,, arachnites
,, aranifera
,, muscifera
Habenaria conopsea
,, bifolia
,, chlorolenca

IRIDEÆ.

Iris fætidissima
,, Pseudacorus

DIOSCAREÆ.

Tamus communis

LILIACEÆ.

Ruscus aculeatus
Polygonatum mutiflorum
Convallaria majalis
Allium vineale
b bulbiferum
c compactum
,, ursinum
Scilla nutans
Paris quadrifolia

JUNCACEÆ.

Juncus bufonius
,, Gerardi

JUNCACEÆ (Continued).

Juncus glancus
,, effusus
,, conglomeratus
Juncus supinus
,, lamprocarpus
Luzula pilosa
,, maxima
,, campestris

TYPHACEÆ.

Sparganium ramosum

AROIDEÆ.

Arum maculatum

LEMNACEÆ.

Lemna trisulca
,, minor

ALISMACEÆ.

Alisma Plantago

NAIADACEÆ.

Triglochin palustre
,, maritimum
Potamogeton natans
,, lucens
,, crispus
,, densus
,, pusillus

CYPERACCÆ.

Eleocharis palustris
Scirpus lacustris
,, maritimus
,, sylvaticus
Erisphorum angustifolium
Carex pulicaris
,, divisa
,, arenaria
,, paniculata
,, vulpina
,, divulsa
,, echinata

CYPRRACCÆ (Continued).

Carex remota
,, ovalis
Carex Goodenowii
,, glauca
,, pilulifera
,, præcox
,, punicca
,, pendula
,, sylvatica
,, lævigata
,, hirta
,, riparia
,, rostrata

GRAMINACEÆ.

Setaria *glauca*
Phalaris *canariensis*
,, arundinacea
Anthoxanthum odoratum
Alopecurus agrestis
,, geniculatus
,, pratensis
Phleum pratense
,, arenarium
Agrostis canina
,, alba
,, vulgaris
Ammophila arundinacea
Dira caryophyllea
,, præcox
Aeschampsia cæspitosa
,, flexuosa
Holcus mollis
,, lanatus
Trisetum flavescens
Avena pubescens
,, pratensis
Arrhenatherum avenaceum
b nodosum
Sieglingia decumbens
Phragmites communis
Cynosurus cristatus
Koeleria cristata
Molinia cærulea

GRAMINACEÆ (Continued).

Catabrosa aquatica
Melica uniflora
Dactylis glomerata
Briza media
Poa annua
,, nemoralis
,, pratensis
,, trivialis
Glyceria fluitans
Festuca rigida
,, loliacea
,, sciuroides
,, ovina
,, elatior
c loliacea
,, arundinacea
Bromus giganteus
,, asper
,, erectus
,, sterilis
,, racemosus
,, mollis
Brachypodium sylvaticum
,, pinnatum
Lolium perenne
Agropyron caninum
,, repens
,, pungens
b littorale
Lepturus filiformis
b incurvatus
Nardus stricta

GRAMINACEÆ (Continued).

Hordeum pratense
,, murimum
,, marilinum

FILICES.

Pteris aqulina
Lomaria spicant
Asplenium Adiantum-nigrum
,, Trichomanes
,, Ruta-muraria
Athyrium Filix-fæmina
Scolopendrium vulgare
,, var
Polystichum lobatum
,, b aculeatum
,, angulare
Lastræa Filix-mas
,, spinulosa
,, dilatata
Polypodium vulgare
b serratum
Ophioglossum vulgatum

EQUISETACEÆ.

Equisetum maximum
,, arvense
,, palustre
,, limosum

CHARACEÆ.

Chara fragilis

86. C.

FOLKESTONE

NATURAL HISTORY

AND

MICROSCOPICAL SOCIETY.

FOUNDED APRIL 4th, 1868.

PROCEEDINGS FOR THE YEAR 1894.

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ELEVENTH SERIES.

FOLKESTONE:
J. English, Printer, Express Works, High Street.

FOLKESTONE

Natural History Society.

PROCEEDINGS FOR THE YEAR 1894.

ELEVENTH SERIES.

JANUARY 16TH, 1894.

This was really the Annual Meeting for the previous year, which it had been found impossible to hold in December. The attendance was small. H. G. Knaggs, Esq., M.D., F.L.S., was elected a member. Dr. T. Eastes, the President, was in the chair, and his address took the form of a paper on

THE ORIGIN AND PROGRESS OF THE SOCIETY.

Five and twenty years ago last spring, in the committee room of the Town Hall, Mr. Ullyett, who had been Secretary to a Natural History Society before he came to Folkestone, proposed to a meeting called together for the purpose that a society be formed in the town for the study of natural history, to be called the Folkestone Natural History Society. This resolution was seconded by Mr. Kennett and carried. Dr. FitzGerald was elected president, and Mr. Ullyett secretary and treasurer at the same meeting, and that is the history of the birthday of a society which is to-night holding its 27th annual meeting. Twenty-five members joined that evening, and it was arranged to have a field day on the first Saturday in every month, but the first was on April 15th, Wednesday in Easter week, instead of on Saturday. Mr. Ullyett read a paper to the members assembled at No. 2 Tower, overlooking the Warren, on "Local Geology," which I have here. It was the first of a very long series of charming papers on all branches of natural history, which our secretary has indefatigably provided in winter and summer, indoors and out

of doors, to try and foster the love of nature, and to increase the knowledge of nature's products and nature's methods amongst all of us who were willing to listen and be taught. The second field day was on May 2nd, at the Canal, at Seab ook. The Rev. E. Langdon read a paper on "Our Freshwater Molluscs," also contained in this journal.

The first microscopical soirée was he'd at Dr. FitzGerald's house on May 13th, when he re d an interesting paper on "The Microscope," and several microscopes and microscopical objects were exhibited.

On June 6th, about forty members assembled near the Warren again, and the Rev. C. L. Acland read a most able paper on "The Fertilizat on of Orchids." I remember that meeting, and the great interest that was shown in the subject, both by the reader of the paper and the members in general.

On June 13th, at a committee meeting, it was arranged that the secretary should confer with the Town Clerk as to the best means to be adopted for obtaining the charge of the Folkestone collection of objects in natural history then existing, and at the same meeting a quarterly journal was proposed, and the Rev. C. L. Acland and the Rev. E. Langdon were appointed editors, but Mr. Acland resigned, and the secretary was appointed in his stead before the first number was issued.

On November 20th, the subject of winter lectures was brought forward by the Rev. C. L. Acland, at a committee meeting. At a meeting in December, the members were asked to assist in getting as many local names of plants and animals as possible. In January, 1869, seven prizes of books, amounting in value to £5 15s. in all, were offered for collections of dried flowering plants, of insects excluding lepidoptera), and of fossils.

In April, 1869, at the annual meeting after one year's work, 60 members were present. In June, 1869, Mr. Mackeson, of Hythe, gave a lecture on "The Geology of the Warren," and remarked on the probability of coal existing at no very great depth, a remark that is very interesting to us who know that within about two miles it has been recently verified. The quarterly magazine was discontinued in October, 1869. In November, an evening class for botany was arranged, and a series of public lectures under the auspices of the society, commenced in January, 1870, when the president took the "Physiology of Respiration" as his subject for the first lecture. At the second annual meeting about 70 members were present.

The care of the Museum in High Street seems to have been taken in hand by the society in 1870, and it was formerly opened on October 4th, by the Mayor. In the same month, classes in botany and geology were formed. Early in 1871, the Rev. C. L. Acland

who had done so much to keep up the society, left Folkestone, much to the regret of Folkestone naturalists.

In 1872, I find 170 members enrolled. At a committee meeting in August, 1872, the formation of Science Classes in Folkestone, in connection with the Department of Science and Art was discussed, and considered advisable and desirable, and the secretary was requested to communicate with the department, and also with the Mayor with a view to calling a public meeting. This public meeting was held on October 2nd, 1872, and classes were formed.

Nothing else of great public importance occurred until January 17th, 1882, when the following resolu ion was passed: "That a memorial to the Town Council be drawn up, praying them to take such measures as shall seem fit to them towards securing a portion of the site occupied by the King's Arms, &c., for a Museum, Reading Room, and School of Science and Art, and that the Committees of the Natural History Society and the School of Science be asked to sign the same officially." The Secretary, in proposing the resolution, said he hoped the members would support it, and though the request to the Corporation might not be granted at first, yet, as in the case of the Free Library, it would prepare the way for it when it was brought forward again. In February, 1884, I find Mr. Walton referring to the necessity of an extension of practical personal work among the members, so that the lists of local productions might be made more complete.

At a committee meeting in December, 1885, it was resolved that papers on literary subjects might be read at the meetings of the society.

The next most important matter was the first meeting of the society in the new Museum on Grace Hill, which occurred on Tuesday, May 15th, 1888, and took the form of a conversazione, with music, and was in every way a great success.

On November 11th, 1890, the first combined meeting of the Natural History and Microscopic Societies was held, and the societies were amalgamated in March, 1892, and some alterations made in the rules. At this same meeting Dr. FitzGerald resigned the presidency, and was made Honorary President, the society remaining for a year without any acting President.

Thus in the past the society has striven to increase the love for natural history and the knowledge and interest therein, by field days, when papers have been read bearing on the geology or botany of the locality, by lectnres of all kinds and on all subjects to the members of the society and to the public, free or at a small cost; by conversaziones held on the same lines, some for the society only, others for the public as well, when specimens of all kinds, living and dead, macroscopic and microscopic, have been exhibited. The publications have been printed with the same object, but I fear have

not had a very large circulation. Then another branch of its work I have alluded to, viz., the efforts to procure a public museum, and then to make it attractive and instructive at the same time. The society spent nearly £100 over this branch of work, and the hours of time given to it I cannot reckon. The gentlemen to whom the society has been most indebted in the past are the Rev. C. L. Acland, Dr. Fitzgerald, and Mr. H. Ullyett. The Rev. C. L. Acland, unfortunately for us, left the town when the society was very young, the amount of time and thought given to it by the original President and the Secretary is simply incredible. I find Dr. FitzGerald would even read two papers at one meeting sometimes, and the range and the interest of the subjects he has treated of are immense. Mr. Ullyett's incessant labour I have already alluded to earlier to-night. Now what do we want to make the society a useful agency in the town for the future as it has been in the past? Well, we want those who love natural history or one branch of it, and who have the leisure to work steadily on at some subject in which they are interested, and to let us have the results, that we may all benefit by them. It is time our local lists were revised and brought up to a level with present knowledge. I hope Mr. Walton will let us have a local list of flowering plants, that it may be published in our annual report. Then it has been suggested, and I quite agree with it, and shall propose it later, that our microscopical evenings shall be only quarterly instead of monthly, and then, I hope, every microscopist in the society will try to bring something of interest for exhibition, that we may all profit by one another's work; and let us remember that the smallest portion of nature's handiwork, studied thoroughly, will show much of interest never known before to the observer, or perhaps to other workers.

What it was that made the original founders of the society anxious to push forward all this work, I cannot exactly say, as I had not the honour of being one of them; but I can give many reasons why I personally delight in anything that spreads far and wide, the love of nature, and the knowledge of her productions. I find nature so charming in all her moods, and her works so beautiful on every side of me, that I wish that everyone may share some of this pleasure. Nature's works are God's works, and the worry and the weariness and the pettiness of our daily life, the friction of things going wrong, the interminable trials of our temper by small matters,—all these things may often be triumphed over and defeated by simply turning from them and losing oneself in the contemplation of some of the beauties of nature. How contemptible all these trifles seem when one turns to the glorious picture of the heavens, as seen on a fine night at this time of the year. Only a few evenings ago, as I was walking home, the moon was at its first quarter, shining softly and clearly; the cluster of the Pleiades, Jupiter brilliant in

its brightness, the great square of Pegasus, high in the heavens, the large cross of Cygnus, the soft blue Capells, and the Red Aldebaran, the Great Bear, Canopus, the striking stars of Gemini the twins, and the magnificent constellation of Orion, all seem to vie with one another in adding a charm to one of the most restful visions ever to be seen. Or turn to a different kind of beauty, the wing of a butterfly, or the plumage of a bird, or the beautiful blue of a little speedwell in flower in June, how perfect each one is in itself, how it can be studied and studied, first by the naked eye, then by the microscope, and yet no boundary is reached so that we can say "this is worked out." The beauties of nature are an incessant source of pleasure to those who will look for them. Do you often walk out of an evening? Make yourself familiar with the stars and constellations, and planets, and the evening will have an ever increasing interest. Are you shut up in a town, do some work with the microscope. I can promise you in it an unfailing source of interest. Do you get into the country occasionally?—learn something about the birds, or the insects, or the shells, or ferns, or mosses, or lichens, and your life will have a steadily increasing interest and continual pleasures.

For another temperament, the waves rushing mountains high, breaking in white foam, tossed by the gale in the moonlight, have a greater fascination, but all minds can find pleasure in some branch of nature's world if they will only try. Let us then, each and all of us, do all we can to spread the love of nature.

A vote of thanks was given for the paper, and the Secretary then read the report of the previous year. The number of members at present was ninety, and the Balance Sheet showed a sum of £7 11s. 8d. in the Treasurer's hands.

Dr. Eastes was re-elected President.

Mr. Walton also as Vice-President.

The following Members were elected on the Committee:—Dr. Knaggs, Rev. W. Hall, Messrs. J. Knight, T. Hambridge, S. Hills, and B. Sawyer.

The Secretary was re-elected, and Mr. S. Hills was chosen as Assistant Secretary and Librarian.

It was proposed by Mr. F. Gell, and carried, that there should be a conversazione at as early a date as possible,

FEBRUARY 6TH, 1884.

The weather was again wild and stormy, but about sixty members and friends assembled. The Secretary (Mr. H. Ullyett) read a paper. illustrated by Lantern Slides, on

THE MAMMOTH AND ITS EXTINCTION.

Very recently I came across a small pamphlet in a corner of my bookshelves which I had evidently read and well-nigh forgotten. Its title was attractive: "*A Day's Elephant Hunting in Essex*, 1880." I read it again. Hunting Elephants in Essex at such a recent date seems doubtless, an improbability;— "perhaps an escape from a menagerie," you may say. No; it was a veritable genuine elephant hunt; and what is more, it was only one of a series of such. About sixty ladies and gentlemen alighted at Ilford Station and at once set out bent on discovering, if not elephants, then traces of elephants, for they knew they were there. Each was armed with a not very formidable weapon,—a kind of combined hammer and pickaxe; in fine, it was a Field Day of the Epping Forest Naturalists,—a visit to the spot where in 1863, the first perfect skull of a British Mammoth was found. A grand specimen it was too, the tusks measuring eight feet eight inches in length. Since that date the remains of over one hundred Mammoths have been disinterred near Ilford, and along with them skulls, bones, and teeth of three kinds of Rhinoceros, Hippopotamus, a second species of Elephant, together with other creatures, in all nineteen species of animals, now mostly extinct.

Tempora mutantur, those peaceful industrious Eastern Counties are now covered with cornfields and pasture grounds. But there *was* a time, long long ago, yet still in the early days of Man, when herds of huge Elephants, Mammoths, and others, wandered among the recesses of a mighty forest, of which Epping and Hainault are now the puny representatives. Up the valley of the Thames they roamed to the west, and with them went the Rhinoceros and Hippopotamus, the Bison and the great Irish Elk, followed not only "by wild cats and lions of enormous size, but also by their greatest foe, Palæolithic Man, armed with his flint weapons of the chase, Far out to the east they strayed, over the bed of the present North Sea, then dry land, and covered with a luxuriant vegetation; and they bathed in and drank of the water of the streams that fed the ancient Rhine, which over that plain worked its way hundreds of miles farther to the north than it does now, receiving tribute from all the eastern rivers of Great Britain, not then an island. During the years 1820—1833, the Norfolk fishermen in

trawling brought up from the bed of the old meadows over 2000 teeth. We would give something to have witnessed that wealth of life (and *such* life) which met the eyes of primæval Man, but which now has well-nigh vanished, leaving us, as Mr. Wallace has said, in "an impoverished world." A few, very few, living travellers have been favoured with such a sight in America, or in Africa, but they never will again; buffalo, giraffe, zebra, and elephant are rapidly following the old Mammoths. But we must not linger on such pictures, or waste our time in regrets; our business this evening lies with the ancient elephants.

In order that we may be able to comprehend what follows more fully something must be said about the zoological group to which the old Mammoth and the present elephants belong, and about its position relatively to other groups.

Once included in the order Ungulata, or Hoofed Animals, it has been found necessary with the advance of our knowledge respecting them to detach the trunk-bearing species, and to form them into an independent and somewhat isolated order, viz., Proboscidea, characterized not merely by the possession of a trunk, but also by certain special features of the feet and teeth, which are so different and yet related to those of horses, cattle, and deer. And in this matter of separation, as in so many other instances, we are reminded again of the close interweaving of the threads of that web which connects all Nature together; of the impossibility of fixing upon any one feature or character by means of which to separate one group from another. We find the same or closely similar features or habits in animals and plants of widely different orders,—a result no doubt of the prevalence and influence at different times and in different places of similar physical surroundings. Just as we find the development of climbing organs in totally different grounps of plants, so there are other animals besides "Proboscideans" possessing a proboscis, varying in almost every possible degree. It would be a very easy task to arrange a graduated succession of forms, beginning with the mobile upper lip of the horse, passing on by the lip-finger of the giraffe and the rhinoceros, by the incipient trunk of the tapir, and so on to the full-formed organ of our elephants. And yet for very cogent reasons the zoologist cannot place them all together. To the Evolutionist the *Proboscidea* proper are confessedly a puzzle, they seem to have sprung into existence almost all at once as it were; none of them can be regarded as the progenitor of the others, nor has any other form yet been discovered likely to have been, "Our present elephant," says one authority, "is one of the strangest and most enigmatical forms." In the genealogical tree by which an attempt has been made to show the pedigree of the various orders of the Mammalia the elephant branch is a detached branch, not to be followed down to its junction with

the main trunk, or to any other branch. "With respect to the progenitors of the Proboscidea we refrain," says Oscar Schmidt, "from any conjecture." At present there are only two species of elephant; they are the sole representatives of the order. From them we go back in thought to the Mammoth and other similar forms which preceded it; thence to the *Mastodon* of greater antiquity, and as companion to that the earliest and the hugest of them all, although possessing a much shorter proboscis, the *Deinotherium*, once classed among the order Sirenia (Sea-cows, the Dugong, Manatee, &c.) These three genera:—*Deinotherium, Mastodon, Elephas,* make up the whole order; the two former are extinct, and the parent stock has yet to be discovered. If anywhere, it will probably be among the bizarre forms with which the Tertiary and Cretaceous rocks of North America appear to be stored.

I will now illustrate by means of a few slides the members of this order, before proceeding to the special part of our subject.

1. Skull of Dinotherium—dug out at Epplesheim in Hesse Darmstadt, 1836. 4½ft long, 5 molars each side—no canines—no incisors above—two developed into down-curved tusks below. No complete skeleton—doubtful about feet.
2. Deinotherium restored.
3. Deinotherium. and Palæotherium—remote ancestor of Tapir, Rhinoceros. and Horse.
4. Mastodon Skeleton.
5. Mastodon restored — lived on much longer in North America—contemporary there with man. Not here.
6. Slide of teeth.
7. Mastodon Tooth.
8. Mammoth and Mastodon—restored.
   Woolly Rhinoceros restored.
9. Mammoth Skeleton—frontal skin.
10. Mammoth restored.

Among the immediately pre-historic mammals the figure of the Mammoth stands out the most conspicuous, and the most familiar to us all. A huge elephant, larger by nearly one half than any modern form, with tusks attaining sometimes a length of 12 or 13 feet. (There is a Mammoth's tusk in the Natural History Museum, London, measuring 12ft. 6in. long), and sometimes describing a semicircle upwards; the neck ridged with a mane extending partly along the back; long shaggy-woolly locks hanging at its sides; the only extinct creature which shares with an ancient rhinoceros the distinction of having been found in the flesh, preserved with a success that would have shamed the most accom-

plished mummy-preparer of Egypt; and above all most interesting to us because associated with the early history of our race. The huge reptiles of the Secondary Age flourished and passed away unmarked by human eye ; the Deinotherium and (on our side of the world at least) the Mastodon never had the honour of receiving a flint arrow head from the bow of the human hunter. But Palœolithic Man chased the shaggy Mammoth, killed him and ate him ; in fact hastened his extinction, as the men of the iron and steel age are hastening that of his modern representative.

So familiar are we with it that its very name, Mammoth, borrowed from some half-savage tribe in the wilds of Siberia, has become an English word, and we use it nowadays to describe anything of monstrous size, Mammoth Caves, Mammoth Springs, Mammoth Hippodromes, &c. In representing the forms of reptiles and even of most of the mammals of past ages we have to depend on the skill of the Comparative Anatomist, and a little exercise of of the artist's imagination ; but we sketch the mammoth as it has been actually seen.

The ages which have elapsed since our Chalk formations became dry land have been divided by geologists into five lesser periods, each numbering probably hundreds of thousands of years. During the first three of them the climate of the northern parts of the world was tropical or sub-tropical, but during the fourth the temperature was gradually lowered, until at last a period set in, so severe that it is known as the Great Ice Age, or the *Glacial Period* ;—a time when the north and West of England were swathed in ice and snow, and glaciers moved slowly down all our great valleys. Astronomers tell us this cold was greatest about 210,000 years ago, and that it disappeared probably about 80,000 years ago, since when the climate has gradually settled into its present condition. Now the Mammoth appears to have been called into existence just before this ice period, and many remains have also been found in inter-glacial deposits, representing milder intervals of a few thousand years, which occasionally prevailed. At the close of the Ice age, however, the Mammoth multiplied exceedingly, but seems always to have favonred a cold climate, for which he was well fitted by his warm covering, not possessed because not required by his modern descendant. Who were his ancestors, how he came here, and where he came from, are questions more easily asked than answered. But he himself is a decidedly tangible creature and it will be interesting to follow out (though in bare outline) the steps by which he became the familiar figure he is to the critical and scientific eye of the nineteenth century.

From very early historical times people were familiar with the occasional occurrence in the soil of huge teeth and bones such as

those on the table before you. But in those days when there were no learned Societies, the love of the marvellous prevailed over all other considerations, and scientific accuracy was of secondary importance, And so these remains were always referred to mythical heroes, giants, or dragons. Even these monstrous teeth were believed to be those of men. Measuring a huge leg bone, or shoulder blade, they calculated by mediæval methods of geometry and arithmetic, the stature of the giant to whom it had once belonged; hence we hear of the skeleton of Orestes, 13ft. long, discovered in Greece; of the great giant of Lucerne, 19ft. high, whose figure still appears in the arms of that city; and of another in Crete forty-six cubits in stature. St. Augustine himself states that he had seen the molar tooth of a man, which would have furnished the substance of a hundred teeth of men of his own day. More than once such teeth have been enshrined in churches as relics of saints, and mammoth bones have been reverently carried in processions. Time would fail us to notice at length the curious tales about these remains.

In our own country, and in our own immediate locality, one may almost say the bones and teeth of the Mammoth are common; we are constantly finding them in brickfields and railway cuttings. On the Continent they are even more plentiful; and when at last men could not avoid the conclusion that they really did belong to elephants, they exercised their ingenuity in many directions in endeavouring to account for their presence. Some said they were antediluvian, which they certainly were; others explained their occurrence by the numbers of elephants brought by the Carthaginian armies in their invasions of the Roman Empire.

The grand hunting ground for the fossil ivory derived from these creatures, is, as already stated, beyond all doubt in Siberia, whence tons of it are exported in regular and systematic trade every year. There is scarcely a river or brook from the Urals to Behring Strait, which does not now and again yield its tribute of bones. When the thaw sets in, in the late spring, and the river banks give way under the pressure of rushing waters, then is the time for the ivory hunter. Tusks and bones are seen projecting from the steep sides. and he seldom fails to make a good thing of them. But he does not secure them all. Enormous quantities are swept down by the streams, and carried out to sea; these are washed up on the low shores of the islands, which are visited by boats in the Summer, and sledges in the Winter, and the cargoes carried away for export. One place called the Island of Bones has supplied China for 500 years, and the trade is brisk still Now these traders could hardly have carried on this lucrative business for centuries without endeavouring now and again to satisfy the ever-questioning spirit of man, and asking Whence? and How? In the absence of definite infor-

mation there is always a tendency to make up for it by the exercise of the imagination. And so, never having seen the mysterious creature to which these teeth belonged, they have legends of an enormous animal which burrows in the earth like a mole, to which the light of day is fatal, and which therefore invariably died whenever it chanced to emerge into the upper air. Hence these bones.

But I have stated that the Mammoth has been seen in the flesh in modern times, though not in a living condition. In these days of American and Australian mutton we have little difficulty in understanding how this may be. If a Mammoth once got frozen up in ice, it would have to stay there till it thawed, however long a time that might be; and certainly the ice would preserve the body from putrefaction. Several examples of bodies so preserved might be given; nine have been recorded; but I will only select two. In 1800 an entire body was discovered at the mouth of one of the Siberian rivers; and a circumstantial account has been left by the Russian naturalist Adams, of another found in 1806. But as the particulars concerning this one are to be found in almost every work on geology, I will read to you an account of the discovery of a carcase found so late as 1846 by a Russian engineer, Lieutenant Benkendorf. Doubt has been thrown upon this by Howorth, but as it is accepted by Boyd Dawkins taken from Middendorf's Travels, and more recently still by Mr. Hutchinson in his book on "Extinct Monsters," I see no reason to regard it as untrustworthy.)

So we are enabled to give a perfectly correct representation of this Elephant of the early world; and few museums are without some of its remains. Undoubtedly the greatest interest of all in connection with the Mammoth is that attaching to its associations with our own early ancestors. In many a cave and river deposit its remains have been found mixed with human bones and implements; and the charred fragments on the hearth shows that they used it for food. Now, notice the next slide on the screen. You see a somewhat rude yet graphic sketch of a Mammoth apparently scratched on some soft substance. You cannot mistake the drawing for that of any other animal, not even for our own elephant. It was found in 1863 in the cave of La Madelaine in the south of France, and it is scratched on a piece of Mammoth tusk. It lay in a medley of flint hatchets, bone needles, flint arrow heads, and human bones; it was certainly drawn by a human hand, no less certainly by Palæolithic Man, *i.e.* by man almost as far back as we have been able to trace his existence. He has in his sketch caught the prominent characteristics of the huge beast—its curved tusks, its shaggy covering; you cannot doubt that the man who drew it had often seen it, and was in fact familiar with it. One wonders whether he did it out of a pure love of drawing, or to while away an idle hour; or whether, as it has been suggested, it was done to

serve as the totem or tribe sign of some chief. But it sets at rest all question as to the co-existence of Man and the Mammoth.

THE DISAPPEARANCE OF THE MAMMOTH.

We now come to consider the cause of the extinction of this huge elephant and of its contemporaries. Some, however, may be disposed at this stage to put the question—why should we do this for the Mammoth particularly, more than is done for other ancient forms of life? The answer to this is, that the disappearance of the Mammoth, and some at least of its contemporaries) seems to have been totally unlike that of other previously existing creatures. The old lizards of the sea, and of the Weald of Kent and Sussex, among the rest, disappeared as far as we know gradually, and owing to the ever-varying change going on in their surroundings. In the life history of their order we can trace a regular progress; the beginnings were small; there was a crescendo, a diminuendo, a final disappearance. But these old elephants, the origin of which is as I have said so difficult for the evolutionist to trace seem to have died out as suddenly as they came. They vanish abruptly, and we might say almost simultaneously, in their wide distribution, in the plenitude of their numbers, in the zenith of their physical development. The remains of older creatures lie singly, scattered; they are rare, and their separate deaths can generally be readily accounted for; whereas the skeletons and carcases of Mammoths lie scattered over northern Asia by thousands, on, or at a very short distance below the surface, unpetrified. This is so with no other creature if we except their immediate associates. Hence the extinction provokes special enquiry and research.

In the opinion of many very thoughtful men the destruction of the Mammoth was closely connected with the disappearance of Palæolithic Man from his former haunts; but in what I have to say, although I cannot help alluding to the human contemporaries of the Mammoth I wish to keep that question quite apart from our present one.

Between the deposits in which the remains of the Mammoth are found, associated with those of the earliest men—men of the Palæolithic Age, and higher deposits containing traces of the men of the Polished Stone Age (Neolithic) there is a "great gap," a very abrupt change. There is no gradation, no evolution traceable, no connection whatever; and this is the case whether the deposits in question occur in caves or in the open grounds. The men of the Early Stone Age were a race of hunters and fishers; they had no domestic animals, and they knew nothing of agriculture; and so far as we know they have left behind no representative races of

themselves* When the Men of the Polished Stone Age appeared they were accompanied by the domestic horse and dog, and agriculture was well developed among them. They were also contemporary with a fresh set of wild animals; the Mammoth and the Woolly Rhinoceros are gone; tho Cave Lion and Cave Bear have disappeared, "the two sets of men, their remains, and their animal companions are sharply and definitely separated by a complete gap. "The deposits of the Mammoth age, and it would seem of the Reindeer Age as well, are covered with beds of yellow earth, brick earth, and earth with angular stones, which antedate the later stone age. These deposits are of the same nature with the superficial gravel, soils, and loess to be found resting on the Pleistocene deposits everywhere in the northern hemisphere, and which have poured into all the old caverns of the Palæocosmic Age." No Mammoth remains occur above such deposits.

What happened between the two great Stone Ages to cause this "gap?" Had it anything to do with the disappearance of the Mammoth?

I am now crossing the borders and entering the Debateable Land, where little is certain, and where every point brought forward will give ample opportunities for discussion, of which I hope many will avail themselves.

You must know that among students of geology there are two schools of thougut, including what are termed *Uniformitarians* and *Catastrophists*. The former, with Sir C. Lyell at their head, believe that physical changes have always been going on in the world in much the same way as they are going on now; the same agents at work—rivers, rain, frost, and fire; and varying little if at all from their present normal rate. It is they who make such enormous demands for past time, as they must necessarily do in order to account for such results at a slow rate. The Catastrophists on the other hand refuse to be bound down in this way; they do not deny the similarity or even the identity of the agencies of change, but they hold that these agencies have in old times acted occasionally with far greater violence and intensity than they ever do at present. And there is a great deal to be said in favour of their views.

Like all enthusiastic partizans, adherents of both sides are apt to make very positive and sweeping assertions occasionally, against which it is necessary that we should be on our guard. You may know them by their use of such phrases as—"It can easily be shown, &c." "It is a well-established fact, &c." "This theory is now exploded, &c., &c. Several "exploded" theories have lately

* The Statement refers only to the Men of the River Drifts, not to the Cave-men who may possibly be represented now by the Eskimos.

shown decided and unmistakable signs of life, and that too at the hands of men whose authority cannot be questioned.

Well, we should get from the members of these two opposing schools, varying explanations of the disappearance of the Mammoth, some telling us it was gradual and made complete by man, others argue for a great catastrophe, a sudden flood of waters, that drowned and buried them at the same time. Before entering, however on the disputed explanation, let me put before you the chief points to be considered in the matter. They have been collected and selected with great care by Sir H. Howorth in his book, "The Mammoth and the Flood;" and though he is a Catastrophist in his explanation, even the Uniformitarians will not be able to question his facts, for which in every instance he gives his authority.

I. Consider the enormous abundance of the remains, and their wide distribution, not only in Siberia, but in our own country, and in many caves and rock fissures in Europe, I have already touched upon this; I will add a few more particulars. "From the caves in the Vale of Clwyd (in N. Wales) as many as 400 teeth of rhinoceros, 500 of horse, 180 of hyæna, and 15 of mammoth have been taken." Twenty tons of bones of hippopotamus and others have been taken from a single cave in Sicily." How came these miscellaneous collections in caves? In Siberia we find a regular and profitable trade in "fossil ivory" as it is called. For nearly 300 years England has imported it. In 1872, 1630 tusks were entered at London Docks, and in the next year, 1140,—all Mammoth; and it is calculated that 110,000 lbs. of fossil ivory go to market every year. Nordenskiold considers that the spoils of at least 20,000 Mammoths have already been gathered, and "we can well believe in the rich mine that still remains." Again, in 1821 no less a quantity than 20,000lbs. of ivory was obtained from (the Islands of) New Siberia alone." One traveller in the space of a verst (3500) ft. "found ten tusks sticking out of the ground," and the Liachov Islands seem to be simply piles of bones and tusks. How came these all so thickly gathered together. Was it the same agency that piled them also in the caves? What agency? Floods of water?

Probably yes: then comes the question—Where were they brought from? The answer to this would be from the banks of the streams, where so many skeletons still lie embedded, and some with the flesh attached.

II. How came they where we find them in the river banks? Did these float down the stream from more southern parts? Some say yes. But how could entire carcases float for hundreds of miles and yet retain (as some do) their flesh and long hair intact? They are found by the sides of long and short rivers, main streams and small tributaries; by rivers flowing north and by rivers flowing

south; they are found in Kamtschatka where there are no rivers from southern parts down which they could have floated; they are also found on summits where no rivers could ever come, and they have been found standing upright, as if they had sunk down in a marsh, and been frozen in that position. No; the floating theory will not do.

III. They must have lived in the locality where we find them. "We can hardly doubt," says James Geikie, "that the animals actually occupied the low lying tracts through which the rivers of northern Asia flow." The difficulty arising from the cold *climate* no longer meets us, now that we know the Mammoth to have been thickly covered with hair. But there *is* at first sight a difficulty with regard to *food*. Herds of Elephants and Rhinoceroses could not live in Siberia *now*. Fortunately in certain specimens of Mammoth and the woolly Rhinoceros the remains of the last meal have been found in the interstices of the teeth, in the stomach, or between the ribs where the stomach used to be. These remains have been carefully examined, and were found to consist of fragments of coniferous wood, leaves, and plants, some of which still grow in the more southern parts of Siberia* Similar debris is largely found in some spots in the same beds as the Mammoth skeletons, and with it helices and other land shells now found farther south. Such deposits "consist generally of clay alternating with layers of vegetable matter, like the similar layers on the banks of the tundra lakes, of water mosses, grass, roots, leaves, pieces of branches, and layers of low weeds. * * Where the lakes on the tundra have grown small and shallow, we find on and near their banks a layer of turf, under which in many places are remains of trees in good condition. * * I found in a place where larches now only grow in sheltered valleys prostrate larch trees still bearing cones." In some parts the old dead trunks are so abundant that no other fuel is used. "Hills of drift wood, 250—300ft. high lie on declivities facing south in New Siberia." Food then *was* plentiful; it is not now. Hence there has been some change in the climate.

IV. The Destruction must have been sudden. Such carcases as have been found in ice must have been frozen up directly after death, and must have remained so ever since. "Whatever," says Dr. Buckland, "may have been the climate of the coast of Siberia in antecedent times, not only was it intensely cold within a few days after the mammoth perished, but it has continued cold from that time to the present hour." The same opinion is expressed by Sir C. Lyell. And the frozen ground in which we find the body must have been soft at the time of burial, and have frozen immediately after. And as "we cannot postulate a separate

* Note also the contents of the stomach in the specimen examined by the Russian engineer Benkendorf.

climatic cataclysm for each individual case and locality, we are forced to the conclusion that the now permanently frozen zone in Asia became frozen all at the same time, and from the same causes." The cause, whatever it was, by which these entombments were produced, was so sudden, that it took full effect within the lifetime of one generation of animals. (Dawson.)

Then how was this Destruction brought about? I will give you the explanation in Sir H. Howorth's own words; if I gave it in my own, I should spoil it. "The facts constrain us to one inevitable conclusion, namely, that the Mammoth and its companions perished by some wide-spread catastrophe which operated over a wide area and not through the slow processes of the ordinary struggle for existence, and that the greater part of the remains we find in Siberia and Europe are not the result of gradual accumulation under normal causes for untold ages, but the result of one of Nature's hecatombs on a grand and wide spread scale, when a vast fauna perished simultaneously. We must next inquire what the nature of this catastrophe was. Let us, then, focus the necessary conditions. We want a cause that should kill the animals, and yet not break to pieces their bodies, or even mutilate them, a cause which would in some cases disintegrate the skeletons without weathering the bones. We want a cause that would not merely do this, as a wide-spread murrain or plague might, but one which would bury the bodies, as well as kill the animals, which could take up gravel and clay and lay them down again, and which could sweep together animals of different sizes and species, and mix them with trees and other debris of vegetation. What cause competent to do this is known to us, except rushing water on a great scale? Water would drown the animals and yet would not multilate the bodies. It would kill them all with complete impartiality, irrespective of their strength, age, or size. It would take up clay and earth, and cover the bodies with it." So far Howorth. This explanation serves for the confused collections in caves also. The occurrence of mixed remains on high ground can only be explaned on the theory that the creatures sought refuge there from an advancing flood of waters. The deposits covering Mammoth remains "prove, that at the close of the Palœocosmic Age a deluge of water swept over our continents and caused the physical break between the earlier and later human ages. This great catastrophe was preceded in Europe at least by a gradual refrigeration, and a progressive extinction of the larger animals, and was followed by a diminished size of the continents and by the advent over the depopulated surface of a more limited fauna and a new race of men." (Dawson.)

"I believe," says Howorth, "that the evidence furnished by the Mammoth itself is not only consistent with the conclusion that

that animal and its companions were finally extinguished by a sudden catastrophe, involving a great diluvial movement over all the Northern hemisphere from the Pyrenees to Behring Strait, but it is consistent with no other conclusion." He has with him in this opinion Dr. Buckland, Sir J. Dawson, Duke of Argyll and several others, English and Foreign. This is then the explanation given by the Catastrophists. As to the cause of such a wide-spread flood, there is much doubt; but it is generally believed to have arisen from "some immense submergence and some corresponding re-elevation during and towards the end of the Glacial Age." (D. Argyll—19 Cent., February, 1894.)

The authority of Professor Prestwich is claimed in support of this submergence. The Post-glacial Period says Sir J. Dawson "was terminated by a great and very general subsidence, accompanied by the disappearance of Palæocosmic man and some large mammalia."

By the Uniformitarians we are told that the Mammoth disappeared gradually as other creatures did, though there may have been local instances of many meeting a sudden death at once. "Herds of the Mammoth and Woolly Rhinoceros," says Professor Prestwich, "seem to have been destroyed in early Quaternary times. Swept down by the river floods and entombed in the ever-increasing annual ice-growth of the Glacial Period, there they had remained for untold ages, until now released by Summer thaws."

No geologist will deny the existence of widely flooded and marshy lands during the time that the accumulation of ice lasted. Every Summer the melting of the ice must have caused these, and during those milder periods known as inter-glacial these floods must have been excessive. Mr. Skertchly, a great authority on the Fen District, speaking of the gravels and sands in the Eastern Counties says "every phase of their character shows that they are the effect of great floods sweeping across the face of the country." These floods increased in violence and extent towards the close of the Ice Age. "Whilst the last ice-sheet was disappearing" says the greatest authority we have on those times (James Geikie) "great floods from the melting ice swept over the low grounds of England. To this period must be attributed those tumultuous deposits with palæolithic implements and mammalian remains which are scattered over hill and valley alike. No mere river action can possibly account for the appearance presented by these confused accumulations; they clearly indicate the flow of immense bodies of water. When the final melting ensued the floods probably increased still more so as to inundate wide regions with torrential waters." (Ice Age, p. 534 abbreviated.)

There is no difficulty in our imagining that there must have been great loss of life among the animals during such floods as those

referred to; and it helps to explain, or rather to confirm the explanation of, the Mammoth meeting its death by drowning and its preservation by frost. Uncertainty, however, lies in deciding whether these annual and secular floods caused its extinction gradually, or whether as some believe one great flood came and swept them all away.

A short discussion took place, and the usual vote of thanks was awarded.

The President then alluded to the sudden death of one of the earliest members of the Society, John Clarke, Esq.; and proposed "That the Members of the Folkestone Natural History and Microscopical Society desire to convey to Mrs. John Clarke the expression of their sense of the great loss she has so unexpectedly sustained, and their heartfelt sympathy with her in her bereavement."

The Secretary seconded this, and undertook to forward it to Mrs. Clark·

MARCH 6TH, 1894,

There was a large attendance.—Captain Gordon McDakin, the President of the Dover Field Club gave a lecture on "The Crocodile; with personal reminiscences."

After briefly alluding to the symbolism and adoration of the Crocodile among the Egyptians, the lecturer described its classification and relationship to other animals, living and extinct. He pointed out the distinction between it and the Alligator, and then described its skeleton. Its habits and enemies were then alluded to, and several anecdotes from the lecturer's own experience in India were given. The lecture was well illustrated by Lantern Slides, and a warm vote of thanks was accorded, coupled with a widely expressed wish to hear Captain McDakin again.

Three new members were elected.

APRIL 3RD, 1894.

We take the liberty of quoting the following account of the Conversazione held this evening, from the Folkestone Express.

A most successful conversazione from every point of view was held at the Free Library, on Tuesday evening, under the auspices of the Natural History Society. The lecture hall was filled with a magnificent array of exhibits, and the museum was also thrown open to the Company. The platform in the Lecture Hall, and the passage leading to the museum, were effectively decorated with flowers and plants. The proceedings were enlivened by the following choice and select programme of music, which was rendered at intervals during the evening and was much appreciated.

Part song, "Drops of Rain"; violin solo, "Bolero," Miss D. Wood; song, "Where the Bee Sucks," Master Percy Norman; part song, "Sleep Darling Sleep;" song, "Orpheus with his lute," Miss Lloyd-Jones; pianoforte solo, "Saltarello," Miss Longley, L.R.A.M.; part song, "Two Cupids"; song, "The Charmed Cup," Mr. W. G. Sidey; song, Mrs. Lindley White; violin solo, "Tarentelle," Miss D. Wood; song, "A Life's Lesson," Miss Hall; part song, "Cherry Ripe," Mr. F. E. Fletcher, Mus. Bac., F.R.C.O., presided at the piano. Refreshments were also provided. The President of the Society, Dr. T. Eastes, expressed his pleasure at the privilege of welcoming so many to the conversazione. He hoped that it would serve to deepen and increase their interest in Natural History, the most interesting of the sciences, and also in the Society itself, so that at the end of the year they might have more members than they had ever had before. He also hoped that it would be the means of inducing several who had a little time to spare, to make observations themselves, and then give the Society the benefit of their knowledge. During the evening, Mr. Walton concisely explained the various botanical specimens which he exhibited, and Mr. Ullyett also gave a very interesting account of the fossils in the museum. A phonograph proved a great attraction, and was well patronized throughout the evening. Microscopes were exhibited by Miss Hewett, Mr. Peden, Mr. Harris, Mr. Stainer, Mr. Horsnaill (Dover) Mr. Hambridge and Mr. Nicholson. The Entomological specimens were exhibited by Miss Melhuish and Mr. Ullyett, and a magnificent display of local micro-lepidoptera collected within a radius of 20 miles of Folkestone, by Mr. Purdey, attracted considerable notice. Mr. Walton was responsible for an interesting botanical collection, and Messrs. Newman, Scott, and Gell, exhibited several excellent pictures. Dr. Knaggs had a chcice selec ion of views and albums, containing photographs of scenery in the Faroe Islands, and Mrs. Mac Kee exhibited a sacred Buddist book, commonly called "The Gold Bible," which was brought from the library in King Theebaw's palace, in Madalay, by Captain Mac Kee, when Burmah was annexed by the British, in 1885. It is composed of copper, lacquered over and gilded. A gruesome curio on an adjoining table was the skull of a Mohawk Indian. Mr. Billinghurst showed several specimens of marine life, and Mr. Chippendale's exhibition comprised such interesting objects as lizards, a flying fish, a giraffe's tail, shark's jaw, West Indian king crab, Demerara toad, etc. Mr. Francis exhibited some excellent pen and ink drawings. The various specimens and exhibits were admirably arranged by the Assistant Secretary (Mr. Stuart Hills) and others, to whose assiduous care and energy the complete success of the evening must in some way be attributable.

MAY 1ST, 1894.

A most interesting paper by Mr. Stuart Hills, on Local Lepidoptera was read, illustrated by specimens.

TUESDAY, OCTOBER 2ND, 1894.

The first meeting of the winter session was held, at which about sixty were present. The President, Dr. Thomas Eastes read the following paper on—

PEAS, BEANS, AND BACILLI.

I have gone somewhat off the beaten tract in the choice of a subject for this evening's paper, but I hope it will not be found altogether devoid of interest to my audience. In comparing a full-grown animal with itself in its earliest weeks of life, we see an enormous increase in bulk, in the actual amount of flesh, bone, and blood of which it consists. All this increase of material is obtained in two ways—from food and air; by feeding and by breathing; and excepting the oxygen obtained from the air by respiration, all the rest is practically supplied as food, so that, again excepting oxygen, a man has obtained by swallowing and digesting all the material that has gone to increase his weight since he was a child. When we turn to the Vegetable Kingdom and look at an oak and then at an acorn, we cannot but be struck by the consideration of the enormous amount of material that has to be obtained and assimilated one way and another for that acorn to become an oak. A plant, when once it has emerged from its seedling condition, obtains all that is necessary for its growth in two ways—by its leaves and by its roots. If a plant is analysed chemically, it is found to contain many elements variously combined, but a large proportion of it is made up of four elements, C., O., H., N. (Carbon, oxygen, hydrogen and nitrogen). Roughly speaking, the carbon is obtained from the carbonic acid in the air by the leaves and some of the oxygen, and the rest of the oxygen and the hydrogen chiefly from water by its roots. But what about the N.? (Nitrogen) The air which we breathe, and which surrounds the leaves of plants, consists of about four-fifths of N., and it would seem very natural and simple that this should supply the necessary amount of N. for plant life and growth, but it does nothing of the sort. It is established as an axiom in vegetable physiology that plants cannot make any use of the free N of the air. There are two kinds of compounds containing N., which especially contribute the supply of this element to plants, viz., nitrates or salts of nitric acid, and ammonia and its compounds. Either nitrates or ammonia must then be found by a plant in the soil round its roots if it is to flourish. We will now

turn to another side of the subject. It has been found by experience that a continual growth of the same crop in a field year after year ensures a gradual failure of the crop, of course assuming that the crop is cut and carried every year. This arises from the fact that the particular foods required for that plant are not formed in the earth sufficiently quickly to supply a full amount year after year. But if different crops are sown in rotation, as they do not all require exactly the same proportion of the same compounds, much better crops can be maintained. But in addition to this, certain necessary compounds can be added to the soil as manures, to supply afresh the deficient ingredients. Several manures are used that are specially noted for the amount of N they supply to the soil, either as nitrates or ammonia. These manures are, many of them, very expensive. Some scientific men, working at the chemistry of agriculture, found that when certain leguminous plants were grown in soil, the soil ultimately became much richer in nitrates. Others working at the farmer's side of the question, found that a crop of leguminous plants in the rotation of crops added very much to the success of the latter crops. Many botanists had long known that the Leguminosæ, or plants of the pea and bean tribe, usually had little swellings or nodules like little tubercules on their roots, and these nodules were found to be highly nitrogenous. Recently all these isolated facts, the special property of the chemist, the farmer and the botanist, have been welded together in a most interesting manner by the bacteriologist who makes a special study of bacteria and all microscopic organisms. It is now known that these nodules are little exuberant growths of the roots containing colonies of bacilli. The irritation of the bacilli causes the extra growth in the root thus forming a nodule. It has been proved by experiment that if the plants are grown in sterilised sand or any medium containing no bacilli, the nodules do not form, but if the bacilli are sown in the soil the nodules form, showing that the nodules are a consequence of the presence of the bacilli. The bacilli exist in all ordinary soils, but if there is a large proportion of nitrates already in the soil, then the tubercules are very poorly developed, as the plant does not need them; if there is a great want of nitrates then the tubercles are developed to their utmost degree. It is not known yet what exactly happens to change free nitrogen into a form which the plant can make use of, but it is certain now that the bacilli in some way make the free N of the air which exists in the soil available for the plant, which no other agency is at present known to be capable of doing. It seems to have been proved by some good observers that different bacilli are found in different plants, and that the same bacilli will not grow in the roots of different plants. But I should think that this only applies to different genera or to species of very different habit. It does not seem probable that

species varying very slightly would require difficult bacili. One investigator who was working at this particular subject, has indeed succeeded in showing that in many cases a particular leguminous plant thrives much better when it is supplied with its particular bacilli than when it is supplied with the bacilli of another species. Thus three robinia plants were grown simultaneously; No. 1 was not allowed any bacilli at all, No. 2 was allowed the bacilli from pea-tubercules, and No. 3 the bacilli from robinia, and as a consequence Nos. 1 and 2 in 3½ months were mere bare stalks. No. 3 was a fine well grown plant. Three pea-plants were treated in the same way; No. 1 was supplied with the bacilli from pea-tubercules, No. 2 with bacilli from lupin, and No. 3 with bacilli from robinia. In about eight weeks No. 1 was a thriving plant, No. 3 a poor withered up specimen, and No. 2 rather intermediate. But I don't think this proves that even these three are distinct species of bacilli. Klein has worked at the nodules in the lupin and has found that the bacilli are of two kinds, one about twice as numerous as any other. He says "the examination of the nodules was carried out towards the end of last year; the nodules were very abundant on the roots obtained; some were of a round shape, others oval, some were flat, others more of spheroidal shape; all were more or less eccentrically attached to the roots, in fact, as is well known, were local eccentric thickenings of the roots themselves. A transverse section through a root nodule, shews underneath the brown covering a yellowish brownish mass representing the main cellular tissue of the nodular excrescence, and gradually passing into the cellular and vascular tissues which form the central or axial portion of the root itself." "Examined under a microscope; the yellowish substance is seen to contain large numbers of cylindrical bacilli with rounded ends, and amongst these some which are short oval, and others which are dumb-bells of spherical or short oval corpuscles, but the cylindrical bacilli are barely predominating in numbers" The bacilli are small and rather difficult to see. I saw one or two preparations of them in the Bacteriological Department at the meeting of the British Medical Association held at Bristol in the beginning of last August. They seemed rather smaller than the bacillus of "tuberculosis" and very difficult to observe in a section of the nodule. They are also very slow in staining. The course of proceedings in the formation of the nodule is as follows:—A bacillus at some stage of its life penetrates the point of one of the minute hairs of the root of the plant, and spreads by going through the whole length of the hair into the root itself; its presence there causes the exuberant growth of cells which constitute the nodule, whilst colonies of the bacillis grow in its deeper parts, surrounded by some layers of these cells. The bacilli apparently benefit by the jucies of the plant, whilst the plant benefits by the nitrogen, which in some way, it is

able to assimilate by the help of the bacilli, so that the two are mutually helpful, instead of the one being destructive to the other, as in the case of ordinary parasites. In consequence of this peculiar property of the leguminosæ, crops of this order of plants can be grown without any nitrogenous manures; and, as I mentioned before, nitrogenous manures are very expensive. Experiments are being made in the United States as to whether it is possible to get the bacilli of a leguminous plant to live on the juices of one of the grain-bearing plants such as wheat; so that the latter might be able to make use of the free atmospheric N. The plants selected were the white melilot (Melilotus albe) closely similar to the bokhara clover as the leguminous, and maize as the graminaceous plant. The steps of the investigation have been to make a suitable medium in which the bacilli of the melilot nodules would thrive; to gradually change this medium for a leguminous to a graminaceous nature; at the same time to modify the bacilli by successively transferring them from a highly leguminous medium to a highly and eventually an exclusively graminaceous medium, and finally to inoculate graminaceous plants with the modified bacilli. The leguminous plants eventually used were two, the white melilot and the bean, and the graminaceous plants were maize and oats. A considerable time must elapse before the investigation is completed, but so far the indications are that the bacilli of leguminous plants are capable of being sufficiently modified to develope to a certain extent in the root cells of maize; on the other hand, no visible effect has yet been produced in the case of oats. Investigations of this character cannot be unduly hurried, and much work has yet to done in completing the details of the discoveries already made. It is desirable to learn for example the exact *role* of the bacilli and what course of changes the free N. of the air undergoes in its migration into the plants. Questions such as these will no doubt be answered in time, and the near future promises to be fruitful in the solution of problems which must have a profound bearing upon the development of economic agriculture.

To recapitulate briefly: Plants of the natural order Leguminosæ have little nodules in their roots. These nodules contain colonies of bacilli. These bacilli live on the juices of the plant, and at the same time have some effect on the N. of the air which exists in the soil, so that the nodules contain an unduly large proportion of N. This storage of N. is made use of by the plant in its developement. Thus leguminous plants can obtain the N. they require for growth in soils in which nitrates are deficient, so that other crops would require costly nitrogenous manures. The roots of these leguminous plants, being left in the soil, make the soil richly nitrogenous for the next crop. A problem now waiting solution is this—Can wheat, oats, barley, and maize be supplied with a bacillus which

will do the same for them, and enable them to be grown successfully without nitrogenous manures?

A brief discussion followed, in which Dr. FitzGerald, Mr. Walton, and others took part, and a cordial vote of thanks to the President for his excellent paper was passed. The next meeting will take place on the first Tuesday in November, when Mr. Henry Ullyett will read a paper on the "Evolution of the Horse."

A short discussion ensued and a hearty vote of thanks proposed by Dr. Fitz-Gerald was carried. About sixty members were present.

November 13th, 1891.

Fifty members and friends were present. The following paper on the Life History of the Fresh Water Hydra, written by Miss Knight was read by Mr. Knight. It was well illustrated by diagrams and was followed by a discussion.

THE FRESH-WATER HYDRA—*Hydra viridis.*

There is an old story of the Greeks, in which we were interested in our school days, which tells us that there was a celebrated monster to which the name of Hydra was given which infested the neighbourhood of Lake Lerna. It had a hundred heads according to Diodorus, and as soon as one was cut off two immediately grew up unless the wound was cauterized. It was one of the labours of Hercules to destroy this monster, which he accomplished.

The modern hydra probably obtained its name from this fable, but it was quite a different sort of animal, although at one time its story created as much excitement in the scientific world, as that of the monster Hydra could have done amongst the Greeks. The little animal to which this name is applied can be regarded as the type of the third sub-kingdom of animals, that known as *Cœlenterata*; which include jelly fishes and sea-anemones, animals having a stomach cavity and a body cavity as an out-growth there from, and a radiate symmetry; also a mouth bordered with tentacles armed with thread cells. It is very commonly found in ponds and ditches, adhering to aquatic plants. If a tuft of water crowfoot be placed in a vessel of water exposed to the light it is most probable that in half an-hour we should see the Hydra in its native element. It does sometimes attain nearly an inch in length, but is rarely more than half an inch, it possesses a cylindrical body having a mouth at one end, and a disc at the other for voluntary attachment. Around the mouth are 6, 7, or even 10 slender contractile arms, radiating from the body like a star, moving up and down in all directions, and then retracting until the animal seems to be a mere mass of jelly; then in an instant all is activity again.

The body wall is composed of two membranes, an outer and an inner. The former is called the *Ectoderm*; making up the entire outer surface, it is colourless and forms about one-third of the entire thickness of the body wall; and the latter the *Endoderm*, or inner skin lining the interior of the body, which consists of a simple stomach cavity from which effete matters are ejected by means of the mouth. This makes up about two-thirds of the entire thickness of the body wall, and is coloured green or brown according to the species of Hydra examined.

Between the Ectoderm and Endoderm is a very thin gelatinous layer which is hardly visible with a low power. The *Hypostome*, or oval cone, is the part of the body above the tentacles, which is conical when protuded, the mouth being situated at its apex. The tentacles, which are hollow cavities continuous with the gastric cavity are arranged in a simple whorl around the base of the hypostome; when fully extended they are two or three times the length of the body; when entirely contracted they are scarcely visible. They exercise power over living prey much greater than would be expected from their size. On close inspection the tentacles are seen to be covered with minute sacs whose outer thin walls are easily burst by pressure, and when this occurs a long whiplash-like filament which lay coiled within the cell is suddenly projected, thus rendering the tentacle a formidable organ for seizing prey, the action being either mechanical or by virtue of the possession of some poisonous fluid which benumbs the prey, so that it falls a ready victim. This stinging process is denied by Lewes in his "Seaside Studies."

I will now give, in a slightly different form, his words on this point. He begins thus: "I saw the tiny water fleas drop apparently lifeless to the bottom of the phial, after being held for some time by the tentacles of the Hydra, and, intently watching them, I saw them at last swim away again as lively as before. I removed a hydra from the phial, in a little water and placing it on a slip of glass, allowed it to settle and expand there for two hours, when I added several water fleas to the little pond and patiently watched them swimming to and fro. Repeatedly they touched the tentacles in their course, but were not hurt, were not even arrested. At length one was caught and held for some seconds; it then fell to the bottom and remained motionless for at least two minutes, after which it started up and was off as if its course had never been arrested. This certainly had very much the appearance of a case of slight paralysis; the animal seemed arrested by some benumbing influence which for two minutes rendered it powerless. At the expiration of that time it seemed to have sufficiently recovered itself to swim away. If observation alone sufficed, in questions

so complex as those of Biology, this observation would have confirmed the statements of Siebold, Corda, and Owen; viz.: that there is a secretion of a poison which enters the wound. But observation alone does not suffice. I bethought me of a simple experiment. With a needle I gently arrested one of these water fleas; it suddenly sank motionless, remained thus for more than a minute, and then darted off again. Thrice I repeated this act, and each time with a similar result. Will anyone say the needle had a paralysing power, or a benumbing poison which was secreted when the animal came in contact with it? And, does not the reader at once recognise in this sudden motionlessness of the animal a very familiar phenomenon? The spider, the crab, the oniscus, and very many animals 'sham dead,' as schoolboys know, when danger threatens; these water-fleas 'sham dead' when the Polype or the needle touches them. I might have vested my incredulity on this one experiment, but I confirmed it in other ways. Dropping the larva of a Sphemeon into the phial containing the Hydræ, I observed it caught by three different Hydrae; it did not 'sham dead,' but tore itself away without visible hurt. Nay, I also observed one of those animalculæ known as 'paste-eels' for some time in contact with the teutach of a Hydræ on the stage of a microscope, but, in spite of its having no shell to protect it from poison, it was unhurt by the contact. Not having a Naïs I could not test what Siebold says of it, but what has already been mentioned must, I think, suffice to convince the reader that the current opinion is an error, founded on observation unverified by experiment. It was only by verification according to the demands of inductive scepticism, that the error became obvious."

A few days after Lewes had written the above extract, he obtained a supply of Naïds, and found them, like the other specimens before acted upon, to be absolutely unhurt by the contact with the tentacles of Hydra.

With regard to the power possessed by these ever moving limbs, if one may so call them, of the Hydra, Baker in the History of the Polype writes: "'Tis a fine entertainment to behold the dexterity of a polype in the mastering of its prey, and observe with what art it evades and overcomes the superior strength and agility thereof. Many times by way of experiment, I have put a large worm in the very extremity of a single arm, which was instantly fastened on it with its little invisible claspers. Then it has afforded me inexpressible pleasure to see the polype poising and balancing the worm, with no less seeming caution and judgment than a skilful angler shows, when he perceives a heavy fish at the end of a single hair line, and fears, it should break away. Contracting the arm that holds it by very slow degrees, he brings it within reach of his other arms, which eagerly clasping round it, and the danger of

losing it being over, all the former caution and gentleness are laid aside, it is pulled to the polype's mouth with a surprising violence."

I think as much time as can be spared has now been given to the notice of the tentacles, so we will pass on; we next see that the outline of the gastric cavity and its extension into tentacles is dark owing to the presence of chlorophyll corpuscles which are contained in the endoderm cells. The ectoderm being transparent, as before stated, gives the light outer border to the parts. At the end of the animal opposite to the mouth is the *pedal disc*, the ectoderm cells of which secrete a clear tenacious fluid, emit pseudopodia by which the animal slowly moves (Pseudopodia are the blunt processes protruded by low forms of life for purposes of locomotion).

Now to examine the ectoderm more closely; we saw before that it forms the outer layer of the body wall. It consists of—(1) Covering cells, the surfaces of which are exposed along the body and base irregularly, the latter reaching to the supporting lamina. (2) Epithelial muscle cells, the surface of which is exposed; the base forming the muscular filament, and is applied to the supporting lamina. (3) Interstitial cells, which are small irregular masses between the base of (1) *i.e.*, the covering cells. (4) Young cnidoblasts which are deeply placed. (5) Fully formed cnidoblasts which are superficial. In the cnidoblast the nemalocyst or thread cell is developed, the parent cell persisting as a capsule surrounding it, and is produced at its outer or free surface into a small process, the cnidocil. (6) Gland cells, these are restricted to the pedal disc. (7) Ganglion cells, with numerous outrunners continuous as in the endoderm with the cnidoblasts. Sense cells appear to be wanting.

A supporting lamina separates the ectoderm from the endoderm everywhere except at the mouth. It is delicate, containing filaments for both ecto and endodermal muscle cells. The endodermal cells are ciliated, of variable shapes, and during life are amœboid, *i.e.* changing. Endodermal cells, so called, which contain chlorophyll corpuscles are vacuolated to a certain extent, the vacuoles in some cases being so large as to reduce the protoplasm of the cell to a very thin peripheral lamella These cells throw out pseudopodia during digestion and also develop in the walls of the gastric cavity muscle filaments which move both circularly and longitudinally.

Professor Ray Lankester by his Researches on Hydra and Spongilla has clearly established the fact that the green bodies of these animals have not the value of cells. They are devoid of nucleus and membrane. The chlorophyll bodies in Hydra closely resemble the corresponding structures in plants, and appear like them to multiply by fission. They are at one time entirely absent from the ovum, which is the only ectoderm cell that contains them.

Klumenberg traced their origin in it from colourless bodies. Hamaan, on the contrary, states that they migrate into it from the endoderm; but he appears to start from the point of view of their algae nature, and to be like some other observers ignorant of the fact that chlorophyll bodies multiply by fission. It may be added that Hydra viridis is unlike Spongilla or the Fresh-water Sponge; (1) when confined in the dark it does not lose its colour, and that in some green varieties green angular bodies have been found similar to the colourless angular bodies of Hydra fusca which is brown in colour, the lower part of the body being attenuated into a kind of stalk, (2) the presence of small granular gland cells on the hypostume, (3) in having vacuolated gland cells at the base of the gastric cavity.

According to Zickeli, cnidoblasts are present in the endoderm, while the chlorophyll corpuscles are present chiefly in the marginal part of the endoderm cells, and found plentiful in their base. These corpuscles are spherical and consist of an outer envelope containing the chlorophyll, usually entire but sometimes in plates, with central protoplasinic contents, and therefore resemble the chlorophyll bodies of plants.

With regard to its method of locomotion, Owen in his lectures on the Comparative Anatomy of Invertebrate Animals States. "When the Hydra would change its position, it fixes one of its tentacles to some supporting surface approximate to the head; and advances by leech-like movements. It can move in water as well as on a plane, for it would swim, suspended to the surface of the water by the foot, which is then exposed to the air; this disc then dies, acts as a float and the Hydra can row itself along by one of its tentacles. Its ordinary position is one of rest."

Trembley formerly asserted that the animal could be inverted so that the ciliated epithelinum and hepatic cells were developed on what was the outer-surface of the thread—other ectodermal cells on what was the gastric surface, and by this means digestion would be effected as well on the outer as on the inner surface, and the animal continue to live. This view has however been disproved by modern researches.

The Hydra is mostly celebrated for its marvellous powers of reproduction. This is in the ordinary way achieved by germination or budding from any part of the body except the tentacles. Sometimes two or three are proceeding at one time from the same individual. A little tubercle rises on the body of the parent, which enlarges every hour, and ultimately tentacles appear at the apex, but no sooner are the young thus furnished than they commence catching prey on their own account whilst still attached to the body of their mother, but the bud ultimately constrict at its base, separates becomes an independent animal. The rate of budding

depends largely on the supply of food and on temperature. If a rapidly budding Hydra be transferred to water in which there is little or no food to be obtained, the formation of buds will be stopped, and those already formed may even be absorbed. A single Hydra may develop more than one bud at once, and these may develop secondary buds before separating from the parent animal. In this way temporary colonies may be formed, which however, sooner or later, break up into their component units.

Hydra can also multiply by fission, i.e., it can be cut in two, and each half will become a perfect animal. The process of fission, however, very rarely occurs naturally.

On this subject Johnston on "British Zoophytes" writes :—"If the body is halved in any direction each half in a short time grows a perfect hydra ; if it is cut into four or eight or even minced up into forty pieces each continues alive and develops a new animal, which is itself capable of being multiplied in the same extraordinary manner. If the section is made lengthwise, so as to divide the body into two or more slips, merely connected by the tail, they are speedily resoldered like some heroes of fairy tale, into one perfect whole ; or if the pieces are kept asunder each will become a polyp : and thus we may have two or several polypes with only one tail between them, but if the section be made in a contrary direction from tail towards the tentacles, you produce a monster with two or more bodies and only one head. If the tentacles—the organs by which they take their prey, on which their existence might seem to depend—are cut away, they are reproduced, and the lopt off parts do not remain long without a new body.

"If only two or three tentacles are embraced in the section, the result is the same, and a single tentacle will serve for the evolution of a complete creature. When a piece is cut out of the body, the wound speedily heals, and as if excited by the stimulus of the knife, young polypes sprout from the wound more abundantly, and in preference to the unscarred parts ; when a polype is introduced by the tail into another's body the two unite and form one individual ; and when a head is lopt off it may be safely engrafted on the body of any other which may chance to want one . . . . And the creature even suffers very little by these apparently cruel operations.

"Scarce seems to feel, or know
"His wound,

"for before the lapse of two minutes, the upper half of a cross section will expand its tentacles and catch prey as usual ; and the two portions of a longitudinal division will after an hour or two take food and retain it."

I have omitted one sentence from the extract, as I have already alluded to it as discussed and disproved by modern scientists.

This power of reproduction by fission proves the lack of nerve centres. Owen states that he has never observed a bud on the tentacles, nor does a wound on this part lead to development of Hydræ like one on the base of the body, and believes that the greater amount of metamorphosis which the germ cells and nuclei have undergone in the formation of the complex organs of the tentacles is the cause of this inferior power of generation and regeneration.

And now having followed the Hydra through the various stages of its life, viz., birth, growth, mode of living and multiplication, however imperfectly the work may have been performed, for there is a great deal of subject matter written on this small and apparently unimportant form of life; I must close my paper, asking my hearers to give me their kind indulgence in criticizing my first effort in this line in overlooking its many deficiencies.

DECEMBER 18th, 1894.

This meeting had been postponed from December 4th. Mr. Hy. Ullyett read a paper on the ANCESTRY OF THE HORSE, illustrated by Lantern Slides. From his paper the following extracts are taken.

THE ANCESTRY OF THE HORSE,—A CHAPTER IN EVOLUTION.

In the month of September last, a communication was inserted in the *English Mechanic*, stating, that there was then, at Farnborough, (Kent), a horse having two complete and well formed hoofs on one of its fore-legs, and an illustration of the same was given. The notice was signed by Mr. Alderson, a scientific gentleman living in that neighbourhood, and I took the liberty of writing to him for information, and asking if it were possible to get a photograph of this foot. Although I was quite a stranger to him he replied with the greatest courtesy, telling me that the horse was the property of a travelling showman, and that he would endeavour to get a photo for me. He did so, and by the aid of my friend Mr. Carter, one of our members, I am enabled to place it before you on the screen.

Now this occurrence is by no means unique, it is met with from time to time, and is of the very greatest interest to the student and the scientific man. It cannot be classed under the head of "montrosities" with two headed calves, or six legged kittens. On the contrary it is full of information, its origin is known, and we can understand why it occasionally takes place. It carries us back in thought up the stream of Time into dim and early ages when a fauna and flora, very different to the present, covered the face of the earth. The very *re*currence of the phenomenon from time to

time speaks of law and some kind of regularity;—tells us that there must be a special cause for it, and a way of explaining it. Sometimes both fore-feet are thus provided with an extra hoof, very rarely it occurs on the hind feet,—more rarely still on all four. The latter was the case however with the eight-toed Cuban horse an animal which reached maturity, and underwent the scrutiny of scientific men. The extra hoof, notice is on the inner side, and is always smaller than the normal one. In his recent book on "CREATURES OF OTHER DAYS," Mr. Hutchinson mentions several other instances; he also tells us that "in the museum at Yale College, there is preserved, a specimen of a horse, which, besides having TWO extra toes on each foot, had concealed beneath the skin, the remains of another one corresponding to the human thumb."

Our double-hoofed horse reminds us of similar phenomena in other animals, and starts many questions besides those relating to itself. Why, among the many varieties of pigeons due to the ingenuity of man, do we find repeatedly and unexpectedly a slaty-blue bird with two dark bars across the wings and other markings which its parents did not possess? What is the origin of the spinal and shoulder stripes, found sometimes on the Horse, always on the Ass? How is it that the latter animal, and indeed the former as well, have occasionally (and particularly while young), transverse bars on the legs, leading us to conclude there is some relationship to the Zebra, or the Quagga? if so, what relationship? Do the stripes sometimes found on young lions point to any relationship with the tiger? Questions like these, in reference to both animals and plants, are legion; how can they be answered? I hope in this paper to throw some little light upon them.

The phenomena mentioned are one and all palpable references to a chapter or chapters in the ancestral history of the animals,—exceedingly suggestive, full of information. I may say at once, that apart from the theory of Development, or Evolution, there is no method of explaining them. There is no naturalist of any authority or note in these days who does not, more or less, accept this theory. You can take up no modern work on any branch of Biology, which does not take for granted that all creatures now living in the world are descended from others gone before through a long line of varying ancestors, whose forms grow less and less familiar to us as we travel farther back in time, until we lose ourselves among the undefined lights and shadows of the early world. The theory has been opposed for many years, but has continuously gained ground, as one illustrative proof after another has been brought to light by the anatomist and the palæontologist. In the case of the Horse these proofs and illustrations are more complete and more nearly perfect than in the case of any other creature,

and now-a-days, when any incautious opponent ventures to ask, "Where are the missing links?" the geological Horse is at once trotted out for inspection.

The Lecturer then exhibited on the screen, and described some of the earlier forms of the Hoofed Animals; after which he went on to say:—

All our representations have been of animals belonging to the same great Order as the Horse; but we have noticed a considerable amount of variation in the number of toes on each foot. The horse has one, the Ox two, the Hipparion had three, but probably was supported wholly by the middle one, the Rhinoceros had and still has three, the Hippopotamus four, while the Deer, Giraffe, Pig, &c. walk upon two. The number forms the most evident characteristic to the ordinary observer. But the student detects something beyond this. He finds that the hoofed animals fall easily and naturally into two smaller groups, according as the weight of the body is supported on one or on two specially enlarged toes; these are (a) The Odd-toed (PERISSODACTYLA), (b) The Even-toed (ARTIODACTYLA), the type of the former being the Horse, of the latter, the Ox or Deer. The Palæontologist finds that this division holds good for all their past history, and it is evidently a natural division. The typical number of digits among the Mammalia would appear to be five, but this number at the present time is found only on those animals which use their limbs for purposes other than support or locomotion; e.g., the Mole and the Monkey. In early Tertiary times the number five was much more prevalent than it is now, and was as I said, probably normal. Among the Ungulates the number apparently decreased gradually by disuse as the necessity for them decreased. In those whose favourite habitat lies among soft or marshy ground, the decrease has gone on to a less extent because the spreading out of the toes and a large surface to the foot would be of advantage in giving them a surer footing. "The toes" (of the Hippopotamus) says Sir S. Baker "spread widely upon soft ground, and although not actually web-footed, the skin between each toe expands to a certain degree, which assists the animal's progress when swimming by offering a considerable resistance to the water."

As the old surface land became better drained and drier, it was most advantageous to animals living upon such ground that the surface of the foot should lessen, and with it the number of digits, conferring on them thereby a higher rate of speed, a better chance of escape from their enemies. The group containing the Horse, which includes Ass, Zebra, and Quagga, has altered most of all, and there we find the highest rate of speed, the bones of the limbs having decreased and become more compact, and the whole body lighter. And as already said, this classification by the number of

what we may call "effective" toes, can in no way be regarded as artificial, for along with the digital alterations, others have kept pace in teeth, skull, vertebral column, digestive organs, &c.

At the present time the odd-toed group is far less numerous than the other, both in varieties and in individuals; but in the earlier times it seems to have far outnumbered it. Throughout middle and later Tertiary times the odd-toed species have been continually decreasing, the Horse itself having died out in America; while the even-toed kinds have rapidly increased, and are at present the more numerous, though man in his love of so-called "sport" has, during the last twenty-five or thirty years, been doing his best to reduce them.

Let us now for the remainder of our paper confine our attention to the Horse. But it must be remembered that we are not concerned this evening with what may be styled the *artificial* varieties, such as the racehorse, American trotter, Suffolk or Clydesdale cart-horse, &c. All these owe their being as such to human care and ingenuity; we are to take the true natural "wild" horse as our starting point. Where shall we find it? the true wild horse? Numerous herds of horses running wild are known in Australia, New Zealand, Falkland Isles, N. and S. America, &c., but in each of these cases we have only the descendants of the domesticated horses which have escaped and resumed the feral state. The true Wild Horse, or *Tarpan* is now to be found only in the wildest Steppe district of Asia, and you will notice from the next slide one or two important characteristics distinguising it from our tame varieties. It is a much clumsier, big featured form, rough in general appearance, the mane short, and half-erect,—the last survivor of the ancient pre-historic horse, yet the form from which was derived the last winner of the Derby. The bare fact, that from such as these, man has been able to develop so many forms for his own uses, prepares us to accept the idea of the original pre-historic progenitor having in its turn been evolved from some form older still. The date of the domestication of the Horse is altogether unknown; we find representations of it on the monuments of Assyria and of Ancient Egypt, dating as far back as 1800 or 1900 B.C., introduced into the latter country by the Shepherd Kings, and we have notices of it almost as old as that in our Bible. But it had been subdued by man long before that date; its bones are found mingled with tools and weapons of Early Man, who amused himself in his leisure time by cutting sketches of it on bits of horn or bone, the large muzzle and the short stiff mane being well shown.

Fossil, or rather sub-fossil Horses—true modern forms are found in the most recent of the Tertiary deposits (Pleistocene) in many parts of the world and are not unknown in our own neighbourhood. But below the Pleistocene we cease to find the modern

Horse. Was the *beginning* of the Horse then in Pleistocene times? Was it "created" then? The answer to the last question depends on the meaning of creation. That a totally new creature sprang *suddenly* into existence, a creation in the Miltonic sense,—no. That our Horse did not exist before Pleistocene times, but *has* existed ever since,—yes. Creation is a slow work, not an instant-taneous one,—a gradual change and development, extending, it may be over countless ages before the special form is produced. "Evolution," says Professor Drummond in his last work, "is seen to be neither more nor less than the story of Creation as told by those who know it best." In deposits of slightly older age we find bones and teeth, if not of horses, then of very horse-like animals; in enormous numbers at Pikermi, already mentioned, in France, in Germany, and more sparingly in the crag of Suffolk, &c. To this creature the geologist has given the name *Hipparion*. It is shown on the upper half of the next slide. Notice the projecting toes, the smooth upper part of the tail.

But now, before going any further, let us notice briefly the characteristic points in the structure of the limb of the Horse; that of the fore-leg will be quite sufficient, The fore-leg, as you know, corresponds to our *arm*; consequently there is no *knee* in it; what is usually called the knee is really the wrist, and the space between it and the tip of the hoof, as it is seen in front, corresponds to the back of hand and fingers. Through our hand run five bones, to which are attached the fingers of three joints each, one much longer than the rest, and the thumb of two joints. But in the "hand" of the Horse we find, not five bones, but only one, a very stout bone called the "cannon bone," bearing one finger only, of three joints like our own, the lowest joint of the three bring enclosed in the hoof, which is, as already remarked, neither more nor less than a modified finger-nail. But now, note especially alongside the upper half of the cannon bone, two rudimentary bones, of no use whatever to the horse, and in old age becoming solidified with the cannon bone. These are called the *splint bones*, they reach little more than half-way down, they terminate in a point, and they are enclosed in the skin.—Two apparently useless, supplementary bones; they *are* in fact, useless to our modern horse,—as useless as the letter *b* in *doubt* and other silent functionless letters. You naturally ask, Why are these useless bones there? what do they mean? Much; as we shall presently see. A short time before our modern Horse appeared, herds of a closely similar animal roamed over the plains,—the Hipparion already mentioned. Compare the fore-leg of this form with that of the Horse. Here are the same splint bones, but lengthened out so as to reach the whole length of the cannon bone, while to each of them is attached a slender toe of three joints,—very short however, so short that it

is evident they did not touch the ground, being in this respect like the two small toes at the back of the pig's foot. The teeth, and the other parts of the skeleton of this same Hipparion prove to us that it was a Horse, a three-toed Horse. Notice it once more on the slide. Similar remains are found in deposits of corresponding age in N. America, and although the palæontologists there know it by a different name *Protohippus*, there is no doubt that the European and American species were the same; certainly some of them were, for there were several varieties or species of this three-toed Horse.

Here then is the secret that lies hidden in the splint bones of the modern horse, and the explanation of the extra hoof or hoofs which occasionally develop themselves. They are the visible tokens of the horse's descent from a three-toed form, the vestiges of organs once fully developed; the two side toes having become gradually useless, shrank and at last disappeared, ceased altogether to perfect themselves. And these vestiges will in their turn assuredly, in ages to come (as geologists reckon time) pass out of existence.

But some will still ask, "Why two *useless* toes on the foot of the Hipparion? They were not useless originally. The next slide shows the leg-bones of an older form, found in beds representing Miocene times, the *Anchitherium* or Miohippus, and here you see the two side hoofs were long enough to be used in walking, and were altogether stouter and stronger. How and in what way they ceased to be so used we do not know, but the cessation of their full development would be certainly favourable to the animal, conferring as it would, greater speed.

When geologists had arrived thus far in their progress of discovery they were able to understand that occasionally the Horse reverts to some one or other of its ancestral forms, brings up one of the old fashions again; that the phenomenon of "two-hoofedness" is not to be regarded merely as a curiosity, not as a monstrosity; but that on the contrary it contains a portion of the missing history of the ancestry of the Horse. Such reversion is known as *atavism*, which, I believe is Latin for "great-great-grandfather-ism," but is a much more convenient word to use.

Even before the genealogy of the Horse had been traced thus far back, many high authorities had ventured in their speculations to prophesy that a four-toed, and even a five-toed ancestor would be found. This was one of the most successful instances known of the combination of inductive and deductive reasoning. On the next slide is shown the skeleton of an animal just as it was found by Professor Cope in the Lower Eocene Beds of the Wahsatch Mountains in Utah. It has not, it is true, a very equine look,—seems you will say to have no equine elements about it; yet it is now believed to be the oldest known hoofed animal, the ancestral

form of all the present ungulates. and therefore, of the Horse. It was associated with a form already shown --the *Coryphodon* and also with another,—the *Hyracotherium*. Its own name is *Phenacodus*; in size it was somewhat larger than a sheep, and possessed five hoofed toes on each foot, though possibly only three were used in walking; its brain was very small. Its restored form is shown on the next slide.

We have now got as far back as we can get in our researches at present, though of course the Phenacodus itself, on our theory, must have had ancestors. From this very generalized form, we are taught, different genera and species of hoofed animals were developed along various lines, according as variations in their own structure fell into harmony with the physical conditions by which they were environed. As one geographical change succeeded another, those forms which, by virtue of some fortunate variation in their structure, were able to accommodate themselves to the new conditions, survived and flourished; all who could not do this perished, and such must have been the case with immense numbers. There is a little uncertainty still prevalent as to whether the development of our Horse took place in the Old World, or in the New. Did we receive our horses from America, or did some of our early forms find their way over there? Probably there were developments in both continents. The *Phenacodus* however, has not yet been discovered on this side of the Atlantic. In those same old lake deposits of the Rocky Mountain district occur the remains of a genius they call *Orohippus*, corresponding to the Hyracotherium of the Old World, having four toes on the front legs and three behind; and a little higher in the beds the Mesohippus appears with three toes in front and only a rudimentary fourth. This leads us on to *Miohippus* having the fourth digit in a still more rudimentary condition; and thence to the *Hipparion*, and thus the chain is completed.

About sixty were present and the usual vote of thanks was accorded.

FOLKESTONE RAINFALL FOR 1894,

Kindly furnished by Mr. Stainer.

JANUARY	...	...	2.65
FEBRUARY	...	...	1.62
MARCH	...	...	1.57
APRIL ...	...	...	2.45
MAY ...	...	...	3.53
JUNE ...	...	...	2.29
JULY ...	...	...	4.98
AUGUST	...	...	2.04
SEPTEMBER	...	...	3.74
OCTOBER	...	...	5.45
NOVEMBER	..	...	2.99
DECEMBER	...	...	2.01
		Total ...	35.32

LIST OF SOCIETIES

WITH WHICH "PROCEEDINGS ARE EXCHANGED."

The Scientific Association, Meriden, Conn., U.S.
The Academy of Sciences, New York.
The Academy of Sciences, Philadelphia.
The Elliott Society of Science and Arts, Charlestown.
The Rochester Academy of Science, Rochester, N.Y.
Natural Science Association, Staten Island.
The Imperial German Academy, Hall-on-the-Saale.
The Tunbridge Wells Natural History Society.
The Huddersfield Naturalists' Society.
The East Kent Natural History Society.
The Brighton and Sussex Natural History Society.
The Eastbourne Natural History Society.
The Harrogate Natural and Scientific Society.
The Geological Society, Glasgow.
The Philosophical Society, Glasgow.
The Manchester Microscopical Society.
Societé Scientfique du Chili.

Their publications can be seen on application to the Secretary.

Officers and Rules

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Sea View Villa,
Folkestone.

RULES.

1.—That the Society shall be called "The Folkestone Natural History and Microscopical Society," and its objects shall be to work out the Natural History of the locality, to promote the study of all branches of Natural History, and to facilitate mutual assistance between its members in such study.

2.—The affairs of the Society shall be managed and administered by a President, four Vice-Presidents, an Honorary Secretary and Treasurer, and a Commi·tee of six Members. Three shall form a quorum

3.—The Officers and Committee shall be elected annually at a General Meeting, to be held as provided in Rule 8. A list of nominees shall be prepared by the Committee, and submitted to such Annual Meeting, and the election shall then be taken by show of hands. Any vacancy which may occur during the interval between two Annual Meetings shall be filled in by the Committee, and reported to the Society at the next meeting.

4.—All persons above sixteen years of age are eligible as members. Anyone desiring to join the Society must be proposed and seconded by two members at any ordinary meeting, and may then be elected by a show of hands.

5.—All members shall contribute a Subscription of Five Shillings annually, payable on election, and on each succeeding first of January. Members elected in December shall not be liable for any subscription until the following first of January.

6.—An ordinary Meeting of the Socitey for the election of Members, for reading and discussing papers and correspondence, and for the exhibition of Microscopical and other specimens, shall be held on the first Tuesday in each month at the Museum at 8.15 p.m ; or at any time and place duly notified to the members.

7.—Each member may introduce two friends at any ordinary meeting.

8.—An Annual General Meeting of the Society for the election of Officers and Committee, for receiving and considering the statements of accounts and a report of the Committee on the affairs of the Society, for alteration of rules, and for other business, shall be held in January. Six members shall form a quorum at such meeting.

9.—In the event of it becoming necessary in the interval between two Annual General Meetings to consider any proposed alteration in the Rules, or other matter of special importance, such question may be considered and settled at an ordinary Meeting of the Society, provided that notice thereof has been given to the members.

10.—The Committee may at its discretion make grants of money from its available funds towards paying the expense of illustrating lectures and for the purchase of books on Natural History and Microscopy.

Persons wishing to become Members should apply to the Secretary.

LIST OF BOOKS

Belonging to the Library of the

Folkestone Natural History and Microscopical Society

Micrographic Dictionary. By J. W. Griffith and A. Henfrey. 1883.

Forms of Animal Life. By Prof. G. Rolleston. 1888.

Smithsonian Report—United States National Museum. 1889.

Practical Microscopy. By G. E. Davis. 1889.

Life Histories of North American Birds. By Capt C Bendire. 1892.

Manual of Marine Zoology of the British Isles. By P. H. Gosse—2 vols. 1855-6.

History of British Hydroid Zoophytes. By Rev. T. Hincks—2 vols. 1868.

History of British Sea Anemones and Corals. By P. H. Gosse. 1860.

History of British Starfishes and other Echinodermata. By Prof. E. Forbes. 1841.

History of British Marine Polyzoa. By Rev. T. Hincks—2 vols. 1882.

The Year Book of Science for 1892. Published by Cassell and Co., 1893.

The Year Book of Scientific and Learned Societies for 1893 Published by Griffin and Co.

The Aquarium. By P. H. Gosse

RULES OF THE LENDING LIBRARY.

1.—The books shall be in the custody of Mr. S. Hills, Public Librarian.

2.—Members may obtain any work among them on loan on application to Mr. Hills at such times as the Public Lending Library is open.

3.—Only one work may be taken out at a time by any member.

4.—Each book may be kept seven days, but may be renewed at the end of that time if no other member has applied for it.

5 —A fine of one penny must be paid for each week that a book has been retained without a formal renewal of the same.

6.—All damage beyond ordinary wear must be made good by the borrower.

N.B.—It must be understood that on the evenings of the Society's meetings ALL books out on loan shall be brought and placed on the table; but they may be taken away again at the conclusion of the meeting.

Hy. ULLYETT, Hon. Sec.

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FOLKESTONE.

NATURAL HISTORY

AND

MICROSCOPICAL SOCIETY.

FOUNDED APRIL 4TH, 1868.

PROCEEDINGS FOR THE YEAR 1895.

CONTENTS:

12th and Thirteenth Series.

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FOLKESTONE.

NATURAL HISTORY

AND

MICROSCOPICAL SOCIETY.

FOUNDED APRIL 4TH, 1868.

PROCEEDINGS

FOR THE YEAR 1895.

12th v. THIRTEENTH SERIES.

FOLKESTONE
NATURAL • HISTORY • SOCIETY.

PROCEEDINGS OF THE SOCIETY.

January 15th, 1895.

The Annual Meeting of the Society was held in the Lecture Hall of the Museum, the President being in the chair. About forty members were present. In the absence of the Secretary, the President read the Report. The balance sheet showed that the Society was in debt to the amount of £10.

Mr. Walton then gave some interesting notes on the botanical occurrences of 1894; and Mr. S. G. Hills said a few words on the entomology of the past year. Microscopical objects were shown by Messrs. Rutt, Hambridge, Sawyer and Hills. Mr. W. Saunders exhibited a Phonograph made by himself.

February 19th, 1895.

Fifty members present. The President read the following paper on

BIRDS AND THEIR BEAKS.

(Illustrated by Specimens and Diagrams.)

The true lover of Nature need never be at a loss for something interesting to study. Whatever special line of natural history he cares to investigate, he can always find ample material for thought, study or demonstration. One almost endless source of interest is

the comparison of all the modifications of any one organ in all the plants or animals in which that organ exists; and this comparison will furnish food for reflection and increase in knowledge for the rest of one's life. One of the attractions of Botany is the immense variety of structure and form that one organ exhibits in different plants. Take for instance the corolla. What an interesting series of shapes and modifications it shows even in familiar plants, such as the poppy, the buttercup, the foxglove, the dead nettle, and the dandelion. Even small parts like the anthers show a wonderful variety in their shape, their attachment to the filament of the stamen, and to one another, their mode of opening, and the direction in which they open, as again in the buttercup, the rose, the violet, and the dandelion. In some cases we think we can understand the reasons for these differences; in others, as yet, we cannot, but the interest we can find in such matters is almost endless. At this Society we once had a very interesting paper on Tails. I am to-night going to investigate the other extremity, and give a little attention to the beaks or bills of birds. I have on previous occasions drawn your attention more especially to the general anatomy of birds, and also to the structure, macroscopic and microscopic, of their feathers. Now, before saying anything myself about this interesting and variable part of a bird, I will read what Ruskin has to say on the subject in general in "Love's Meinie:"—"I do not think it is distinctly enough felt by us that the beak of a bird is not only its mouth, but its hand, or, rather, its two hands. For, as its arms and hands are turned into wings, all it has to depend upon, in economical and practical life, is its beak. The beak, therefore, is at once its sword, its carpenter's tool box, and its dressing case, partly also its musical instrument—all this besides its functions of seizing and preparing the food, in which functions alone it has to be a trap, carving knife and teeth, all in one. It is this need of the beak's being a mechanical tool which chiefly regulates the form of a bird's face, as opposed to a four-footed animal's. If the question of food were the only one, we might wonder why there were not more four-footed creatures living on seeds than there are, or why those that do—field mice and the like—have not beaks instead of teeth. But the fact is that a bird's beak is by no means a perfect eating or food seizing instrument. A squirrel is far more dexterous with a nut than a cockatoo, and a dog manages a bone incomparably better than an eagle. But the beak has to do so much more. Pruning feathers, building nests, and the incessant discipline in military arts, are all to be thought of as much as feeding.

Soldiership especially is a much more imperious necessity among birds than quadrupeds; neither lions nor wolves habitually use

claws or teeth in contest with their own species, but birds, for their partners, their nests, their hunting grounds, and their personal dignity, are nearly always in contention. Their courage is unequalled by that of any other race of animals capable of comprehending danger; and their pertinacity and endurance have, in all ages, made them an example to the brave, and an amusement to the base among mankind. Nevertheless, since as sword, as trowel, or as pocket comb, the beak of the bird has to be pointed, the collection of seeds may be conveniently entrusted to this otherwise penetrative instrument, and such foods as can only be obtained by probing crevices, splitting open fissures, or neatly and minutely picking things up, is allotted pre-eminently to the bird species." In writing especially of the robin's beak, Ruskin continues, "You will find that the robin's beak, then, is a very prettily representative one of general bird power. As a weapon, it is very formidable indeed; he can kill an adversary of his own kind with one blow of it in the throat; and is so pugnacious, "valde pugnax," says Linnæus, "ut non una arbor duos capiat erithacos" ("no single tree can hold two cock robins;") and for precision of seizure, the little flat hook at the end of the upper mandible is one of the most delicately formed points of forceps which you can find among the grain eaters."

The bill or beak consists of two parts, the upper and lower mandibles, or more accurately "the maxilla" which is the upper, and "the mandible," the lower part. That part of each which is externally visible is an epidermic sheath of horny or sometimes leathery consistence, which covers the bony part beneath. The bony part beneath is a prolongation of the bones which would form the nose and upper jaw in man for the maxilla, and the lower jaw for the mandible. In most birds this horny sheath, which has a long technical name, rhamphotheca, is in one entire piece for each jaw, but in some, as in the Petrel, it is "pieced" or divided into distinct parts by various lines of slight connection. The different parts of the bill have received names useful for descriptive purposes, but not always easy to remember at once hearing them. The whole length of the middle line of the upper surface from the tip or apex to where the feathers commence on the forehead is called the "culmen." This is an interesting word philologically. It is a contraction of columen, which means "that which rises in height, is prominent, projects;" hence "the point, top, summit, ridge," from the root, "cel," the same as "celsus" high, "collis" a hill. Hence our word "culminating." The lateral sharp edge of the horny covering of either the maxilla or the mandible is the "tomium" from the Greek "temno," I cut. The partwherethe jaws meet behind is "the commissure," or angle of the mouth,

sometimes called the gape. The mandible or lower jaw is composed of two lateral halves, called "rami," or branches, which are separate behind, but united in front. A bird's nostrils are two in number, usually situated near the base of the maxilla, where it joins the forehead, but both their position and their form vary much in different birds. In the Petrels the borders of the nostrils are prolonged forwards in a tubular form, hence their family is named "Tubinares." In some birds, as hawks and parrots, they open in a soft waxy looking covering of the base of the maxilla called "the cere." In the Apteryx alone of existing birds the nostrils open near the tip of the bill, which may be 5½in. long. We will now consider some of the specialities in bills. In the Toucan, *Rhamphach toco*, a tropical bird, the bill is very large in proportion to the size of the bird, but the bone is most delicately cellular, and combines strength with lightness like the pith of the elder, or the flinty skeleton of the sponge *Euplectella*. In the Huia bird, *Heteralocha acutirostris*, the male and female have very different beaks. The male has a thick, somewhat conical beak, 1½in. long, and the female 2½in. long, sharp, thin, and pointed. Its favourite food is the grub of a timber-boring beetle, and the male bird with his short stout bill attacks the more decayed portions of the wood, and chisels out his prey, while the female with her long slender bill probes the holes in the sounder part, the hardness of which resists his weapon; or when he, having removed the decayed portion, is unable to reach the grub, the female comes to his aid and accomplishes what he has failed to do. In many birds the maxilla is sharply hooked at the end, as in the Osprey and many Petrels. In the Crossbill, as the name implies, the ends of the beak are crossed, but not uniformly the same way, as many being crossed one way as the other. This bird is very clever with its peculiar beak in wrenching open the cones of fir trees to procure the seeds. Many bills are compressed, as in the Puffin, the Razorbill, and Australian Crane. Some birds have a straight strong bill, well shown in Woodpeckers; in some it is like a needle, "acicular," as in humming birds, very often beautifully curved at the same time. In the Swordbill it is 3in. long, to enable the birds to catch insects living at the base of a corolla of about the same length. The bill is "decurved" or bent down in the Curlew and the Whimbrel; "recurved" or bent up in the Avocet and Godwit. In the "Helmeted Hornbill" there is a great thickening of bone, and in addition a great mass of horn, being a solid development of the horny sheath, but in the "Rhinoceros Hornbill" this projection is hollow. One class of birds, including the Goatsucker and the Swift, is remarkable for its wide gape, and is called "fissirostrate" or "split bill." In other instances the beak

is rather spoonshaped, as in the Spoonbill and Boatbill. In many birds that feed chiefly in water or mud the beak is rather broad, and its edges are widened and divided on the surface into fine plates or ridges something like the undersurface of a mushroom. When the upper and lower mandibles are nearly closed, this acts like a sieve to filter the water through and retain the particles of food. Geese and ducks show this variety well. In the Shoveler this sieve-like arrangement is beautifully shown. In the Flamingo, the bill is bent downwards at an obtuse angle, and the bird, which has very long legs and neck, sifts the soft mud of the lagoons in which it is wading to feed, by turning its bill upside down, as though it were preparing to stand on its head. The upper mandible is also more movable than the lower in this exceptional bird. The young Flamingo is born with a short straight bill, and this final shape is assumed gradually and comparatively late. In many of our smaller common birds, such as the finches, and the house sparrow, the bill is short, conical, and hard, well adapted for shelling and eating the various seeds that form the chief portion of their diet when adults. Modifications extend in the direction of fineness and delicacy to the beak of the robin, and of massive strength to that of the hawfinch. I have mentioned that the Apteryx or kiwi is the only bird that has its nostrils at the extreme end of the maxilla. Sir W. Butler gives the following account of its behaviour when obtaining its food:—'While hunting for its food the bird makes a continual sniffing sound through the nostrils, which are placed at the extremity of the upper mandible. Whether it is guided as much by touch as by smell, I cannot safely say; but it appears to me that both senses are used in the action. That the sense of touch is highly developed seems quite certain, because the bird, although it may not be audibly sniffing, will always touch the object with the point of its bill, whether in the act of feeding or of surveying the ground; and when shut up in a cage or confined in a room it may be heard all through the night tapping softly at the walls It is interesting to watch the bird. in a state of freedom, foraging for worms, which constitute its principal food; it moves about with a slow action of the body; and the long flexible bill is driven into the soft ground, generally home to the very root, and is either immediately withdrawn with a worm held at the extreme end of the mandibles, or it is gently moved to and fro, by an action of the head and neck, the body of the bird being perfectly steady It is amusing to observe the extreme care and deliberation with which the bird draws the worm from its hiding place, coaxing it out as it were by degrees, instead of pulling roughly or breaking it. On getting the

worm fairly out of the ground, it throws up its head with a jerk, and swallows it whole."

In many birds the covering of the bill near its base and close to the forehead is swollen, and forms various protuberances, horns, knots, and other apparently ornamental excrescences. I have already alluded to the hornbills. In the Coots the sheath is prolonged backwards over the forehead like a yellow plate or shield. Some of the swans have remarkable round knobs in nearly the same place. In the mute or domestic swan, the knob, which is black, is much larger in the male than in the female.

One of the Cotingas of South America, the common Bell bird, is thus described: "He is about the size of the jay. His plumage is white as snow. On his forehead rises a spiral tube nearly three inches long. It is jet black, dotted all over with small white feathers. It has a communication with the palate, and when filled with air it looks like a spire; when empty, it becomes pendulous His note is loud and clear, like the sound of a bell, and may be heard at the distance of three miles. You hear his toll, and then pause for a minute, then another toll, and then a pause again, and then a toll, and again a pause. Then he is silent for six or eight minutes, and then another toll, and so on."

Dr. Eastes concluded by reading "The Chorus of the Birds," from Mr. Courthope's *Paradise of Birds*:—

We wish to declare
    How the birds of the air
All high institutions designed;
And, holding in awe
    Art, Science and Law,
Delivered the same to mankind.

To begin with, of old
    Man went naked and cold
Whenever it pelted or froze,
Till *we* showed him how feathers
    Were proof against weathers,
With that, he bethought him of hose.

And next it was plain
    That he, in the rain,
Was forced to sit dripping and blind,
While the Reed Warbler swung
    In a nest with her young,
Deep sheltered and warm from the wind.

So our homes in the boughs
    Made *him* think of the house,
And the Swallow, to help him invent,
Revealed the best way
    To economise clay,
And bricks to combine with cement.

The knowledge withal
    Of the carpenter's awl
Is drawn from the Nuthatch's bill;
And the Sand Martin's pains
    In the hazel-clad lanes,
Instructed the mason to drill.

Is there *one* of the arts
    More dear to men's hearts?
To the bird's inspiration they owe it,
For the Nightingale first
    Sweet music rehearsed,
Prima-donna, Composer, and Poet.

The Owl's dark retreats
    Showed sages the sweets
Of brooding, to spin, or unravel
Fine webs in one's brain,
    Philosophical—vain;
The Swallows,—the pleasures of travel.

Who chirped in such strain
    Of Greece, Italy, Spain,
And Egypt, that men, when they heard,
Were mad to fly forth
    From the nests in the North,
And follow—the tail of the Bird.

Besides it is true
    To *our* wisdom is due
The knowledge of Sciences all;
And chiefly, those rare
    Metaphysics of Air
Men "Meteorology" call.

And men in their words
    Acknowledge the Birds'
Erudition in weather and star,
For they say, "'Twill be dry—
    The Swallow is high,"
Or, "Rain, for the Chough is afar."

'Twas the Rooks who taught men
Vast pamphlets to pen
Upon social compact and law,
And Parliaments hold
As themselves did of old,
Exclaiming "Hear, hear," for "Caw, Caw."

And whence arose Love?
Go ask of the Dove,
Or behold how the Titmouse unresting,
Still early and late
Ever sings by his mate
To lighten her labours of nesting.

Their bonds never gall,
Though the leaves shoot and fall,
And the seasons roll round in their course,
For their marriage each year
Grows more lovely and dear;
And they know not decrees of Divorce.

That these things are truth
We have learned from our youth,
For our hearts to our customs incline,
As the rivers that roll
From the fount of our soul
Immortal, unchanging, div ne.

Man, simple and old,
In his ages of gold,
Derived from our teaching true light;
And deemed it his praise
In his ancestor's ways,
To govern his footsteps aright.

But the fountain of woes,
Philosophy, rose;
And what between reason and whim,
He has splintered our rules
Into sections and schools,
So the world is made bitter, for *him*.

But the birds, since on earth,
They discovered the worth
Of their souls, and resolved with a vow,
No custom to change
For a new, or a strange,
Have attained unto Paradise, *now*.

Mr. Henry Ullyett proposed a vote of thanks to Dr. Eastes, and took the opportunity of calling attention to one or two points of interest—the way in which the jaws were united in birds and in some reptiles, thus showing their connection. It enabled them to gape and swallow substances very much larger than could otherwise be got down, and it supported the theory of those who believed that some of the birds were developed from reptiles. Turtles and lizards, he remarked, had horny beaks and no teeth, and fossil birds were found with actual teeth. He also referred to cases of malformation of beaks which had come under his notice.

Mr. Nicholson seconded the vote of thanks, which was heartily accorded.

Mr. Walton asked Dr. Eastes if he had given any attention to the point as to what class of beaks made the most perfect nests.

Dr. Eastes replied that he had not.

Mr. Hills asked if anyone could give the reason for the protuberance on the head of a hornbill? Was it used as a protection?

Colonel Frere said he lived in the land where those birds were common. It was subject to terrific monsoons, and the birds selected trees with a proper sized hole in it; the female took her place, and the male commenced to plaster up the hole, leaving nothing of his mate sticking out but just the head, and there she had to sit till the nesting was over. The protuberance was a kind of gutter, and it prevented the rain from running into the nest. The bird used a quantity of yellow oil in dressing its plumage to protect it from the wet.

Mr. Ullyett remarked that it might be what Darwin told them was "female development." The females selected the male with the grandest and most perfect protuberance on its beak.

March 19th, 1895.

Fifty members present, the President in the chair. Mr. S. G Hills read the following paper, illustrated by lantern slides and specimens, on

"PROTECTIVE RESEMBLANCE AND OTHER MEANS OF DEFENCE IN INSECTS, WITH SPECIAL REFERENCE TO BUTTERFLIES AND MOTHS."

In the few words that I shall address to you this evening I propose to put before you some facts which may be new to most, and, I hope, interesting to all, with respect to the protection derived by insects from assimilating themselves by changes of

colour or of shape to the circumstances of their environment. I shall confine myself principally to the order Lepidoptera (*i.e.* butterflies and moths), which forms part of the class Insecta, the most important division of the sub-kingdom Articulata. When we consider the defenceless condition of this order, and the number and rapacity of its enemies, we shall not be surprised if we find that it has special means of protecting itself in the struggle for life. A Lepidopterous insect has four stages of existence, that of the egg, caterpillar, chrysalis, and perfect insect. We will first consider the egg state. The egg is generally laid on the plant which is to supply the future nourishment of the young caterpillar. Some eggs are laid in the autumn, and so have to pass the winter on the plant, waiting for the first green buds to show themselves before they hatch out. Others are laid in the spring and summer, and have to remain but a short time in that condition, as the food is waiting for the young larvæ. Owing to the minuteness of the eggs and the extraordinary care taken in depositing them, they are but seldom found by human enemies; but their chief enemies, the birds, no doubt account for the destruction of a vast number. In 1884 a cuckoo was captured in the garden of the old Charterhouse School, in London, in the intestines of which large numbers of the eggs of the Vapourer moth (*Orgyia antiqua*) were found. This moth is very plentiful in the London squares. Its eggs are deposited on the outside of the cocoon. The eggs of the lackey moth (*Bombyx neustria*) are arranged in spiral batches around the twigs of trees and then coated over with a protecting varnish, while those of the gold and brown-tail moths (*Porthesia chrysorrhœa* and *P. auriflua*) have a covering of fluffy down taken from the abdomen of the female moth. Most of the eggs are deposited on the under surface of the leaves, generally close to the mid rib, while in some orders, those of the wood feeding kind, such as the Ghost and Leopard moths, and all the Clearwings, the female is endowed with a long pointed ovipositor, by which insertions are made in the bark, and the eggs deposited therein. But it is not until we come to the second stage of its existence—viz: the larval or caterpillar—that we find special means of protection exercised. A caterpillar is a very defenceless creature. It has no external skeleton, but is simply a mass of soft tissue. As a rule it has no organs of attack, and but few of defence, with the exceptions that will be mentioned presently. It therefore falls an easy prey to its enemies, and its hope of survival lies in its power of concealing itself. With respect to larvæ, we will first consider instances of Special Protective resemblance. In no class is this more noticeable than in that of the Geometers, or loopers, sometimes called "Stick caterpillars." Those who have ever done any collecting of cater-

pillars will probably have tried "beating," which consists of holding a special apparatus something like an umbrella under a tree, and then with a stout stick threshing the branches above it. On an examination of the contents afterwards, consisting of spiders, beetles, flies, and grub-looking caterpillars, it will be noticed there are what look like a number of twigs; presently, to the surprise of the novice, several of these "twigs" will raise themselves up, and begin to walk off as fast as their legs will carry them. These are the caterpillars of different kinds of geometer moths. It is an extremely numerous family, nearly three hundred species being found in this country; but, until we beat them from their food plant, they are rarely seen, their great resemblance to their environment helping their concealment. They possess only two pairs of claspers, while most other caterpillars have five pairs. These are placed at the posterior part of the body, which is long, thin and round, and stands out like a twig at an acute angle with the stem to which the claspers are tightly fixed. There are often little lumps on the body which resemble buds or irregularities of the bark. In the day time the caterpillar is quite still, not moving until it needs food, which is generally taken at night. As the maintaining of this position for so considerable a time would cause great tension to the caterpillar, it spins a short thread of silk, and attaches itself by this to the adjacent twig; in other cases it fixes itself in a fork of the branch, holding by both ends of the body. To complete the resemblance, the head of these caterpillars is altered from the usual shape into one which suggests the end of a twig "In the caterpillar of the Small Emerald moth (*Hemithea thymiaria*) there are two additional humps on the body-ring behind the head, and the latter is bent forwards and inwards, so that the end of the caterpillar is made up of four blunt projections forming perhaps the most suggestive resemblance to the end of a twig." (*Colours of Animals*, p. 29). Speaking of these protective resemblances, the late Mr. Jenner Weir says:—"After being thirty years an entomologist, I was deceived myself, and took out my pruning scissors to cut from a plum tree a spur which I thought I had overlooked. This turned out to be the larva of a geometer two inches long. I showed it to several members of my family and defined a space of four inches in which it was to be seen, but none of them could perceive that it was a caterpillar."

Last year I was rearing a brood of *Acidalia aversata* (the riband-wave moth) on knot-grass, and on several successive changes of food I noticed that they were gradually disappearing I then determined to count them, and on the next occasion I found I was three or four short. I again carefully scanned the rejected food, but it was not until I passed my fingers down the stems of the

knot-grass that I discovered my missing ones. In their early stages these caterpillars are sometimes green and then they sit on the leaves. Other groups of caterpillars are protected by their resemblance to the bark of trees and to the lichens growing on them, while others again make their surroundings resemble themselves. The caterpillar of the Large Emerald moth when it feeds on the birch resembles a birch catkin; but it also occurs on the alder, and when young, before hibernation, is dull purplish all over; in this state it is like, in size and colour, the unexpanded bud of alder; after the alder shoots, and the caterpillar turns green, it cuts through the juicy stems of the shoots and gnaws them away for food, and then it looks like a young, partly-unfolding leaf projecting from the stem. Those of us who have seen the brightly-coloured caterpillars of the privet and poplar moths might at first be inclined to think they were conspicuous objects, but seen on their respective food plants the bright-coloured markings harmonize very beautifully with their surroundings. These caterpillars, just before they enter the chrysalis state, descend to the ground in order to bury in it, and then their colour changes to a dull purple, in harmony with the colour of the earth. The caterpillar of the Emperor moth (*P. carpini*), which is nearly two inches in length, not only resembles the green colour of the heather upon which it feeds, but the small pinkish purple dots with which it is studded closely imitates the flower buds of the plants, and its habit of twining itself around the stem when alarmed makes it almost impossible at a little distance to distinguish it from the heather. Mr. Poulton (in *Colours of Animals*), gives the results of many experiments showing the power of caterpillars to adjust themselves to the colour of the leaf upon which they feed. The next slide will show the larvæ of a continental noctua (*Catocala elocata*) with the colour adjusted to that of the dark twigs mixed with the food-plant.

Besides resemblance to their surroundings, and power to adapt their colouring to the plants upon which they feed, caterpillars are often brightly coloured, and also possess curious appendages which are used as warning colours and as a means of frightening their enemies. As an instance of warning colours, I may mention those of the caterpillars of the Magpie moth (*Abraxa grossulariata*) and Cinnabar moth (*E. jacobæ*). Although the first named belongs to the "Stick" family it makes no attempt to conceal itself, but all birds, lizards, frogs, etc. either refuse it altogether, or else express great disgust after tasting it. Thus its conspicuous colour warns its enemies that it is uneatable. Another means of defence is that of mimicing vertebrate animals. It is more common in tropical regions than in our own country, but we have an instance of it in

the caterpillar of the Large Elephant Hawk moth (*Chærocampa elpenor*). This caterpillar is seldom seen in the daytime, generally hiding at the roots of its food plant. It possesses eye-like marks on each side of the body, which are not especially distinctive in its normal attitude. On being disturbed, however, it retracts its first segment into its body, and thus swells up its head, bringing into prominence four enormous brutal looking eyes.

In the next example we have a combination of several methods of defence. Most of us know the caterpillar of the Puss moth (*Cerura vinula*) which is frequently found on willow trees. It is a very comical looking creature, with two tails sticking out behind, and with little protuberances on each side of the head like ears. When it is disturbed or annoyed it raises up its head, also its hinder segments, and then withdraws its head into the first body-ring. The two black spots on its body then appear like eyes, giving to the flat place an intensely grotesque and terrifying appearance. From each of its two tails it can protrude a fleshy filament of a pink colour, with the view, it is supposed of driving away ichneumon flies, to the attacks of which it is much exposed, and which have a habit of affixing their eggs behind the head of the caterpillar. This remarkable caterpillar has a still further means of defence, which is rather of an aggressive nature. The lower part of the head is perforated by a slit-like opening, leading into a gland which secretes a clear fluid. It is stored up in a considerable quantity and ejected with great force. If it enters the eye it causes acute pain. The fluid consists of a mixture of formic acid and water. It is probably chiefly used as a defence against the ichneumon flies.

The next example is that of the caterpillar of the Lobster moth (*Stauropus fagi*). It is somewhat rare in this country. This singular larva is reddish-brown, with two humps on each segment from the fifth to the ninth; the anal segments are carried erect, at right angles to the rest of the body; on the last segment are two short tails. When at rest it resembles a withered leaf curled up. "As soon as the larva is disturbed it holds the anterior part erect, and assumes a terrifying position which mimics that of a large spider. All the points in a spider's attitude and appearance which impress the imagination are seized upon by the larva and exaggerated for the sake of effect, while quite novel touches are added with the same object. The hind part of the body is turned so far over the head that the two appendages project over it, and they are at the same time made to emerge. In this position they strongly suggest the appearance of a pair of antennæ, and add an ideal finish to the apparent monster, which is, indeed, exactly like nothing upon earth, but which is nevertheless most effective in its

appeal to the imagination. When the hind part is thus turned forward its ventral surface of course becomes the dorsal sur ace of the abdomen of the supposed spider, and it is appropriately coloured and has an appearance of plumpness which greatly adds to the resemblance. When the larva is much irritated it gently moves this hinder part from side to side, and with it the antennæ-like appendages. This movement also adds to the general effect—(*Colours of Animals*, p. 279-80.)

Another remarkable caterpillar is that of *Bombyx regalis*, one of the largest of the nocturnal lepidoptera of America. When full grown it is about five and a half inches in length. Each segment is armed with a few black setose spines. On the three segments immediately behind the head the spines are of very great length, curved and granular. When it raises its head and draws the anterior segments together it has a very formidable appearance, shaking its head from side to side as if preparing for an attack. By the natives of Virginia it was called the Hickory Horned Devil, and they were so afraid of it that they would not handle it, fearing it as much as a rattlesnake. Other kinds of protection, such as long hair and tussock-like protuberances, we must cursorily mention. Familiar instances of these occur in those of the Garden Tiger (*A. Caja*) and the Pale Tussock (*Dasychira pudibunda*) better known as the Hop-Dog. On being attacked they roll themselves up in a ball, and, on handling them, hairs come out. On the larva of the brown and gold tail moths being touched by the hand, a stinging sensation is felt, lasting in some cases for a few days. This, no doubt, would be very unpleasant to lizards and other insect-eating vertebrates. The caterpillar of one species of moth (*Cataclysta lemnalis*) passes the larva stage in and under water. The eggs are laid on the leaves of *Lemna minor* (the small duckweed that covers our ponds and ditches). On being hatched they soon spin up the leaves of the plant and make themselves a dwelling place. This is generally about half-an-inch in length, the leaves of which it is formed overlapping each other, but in an irregular manner, and so constructed that a leaf or two should hang down and mask the openings at the ends; then the occupant remains quiet within. This much resembles an accidental accumulation of some of the duckweed, so slight is the eminence which it causes above the general level of the surface.

With the mention of the Psychidæ, or case-bearers, the larvæ of which cover themselves with pieces of grass and leaves, and so make a movable house, into which they retreat when alarmed, we must bring this portion of the subject to a close.

We now come to the third stage of the existence of our insect, viz., that of the pupal or chrysalis stage. If it was almost defence-

less in its larval condition, although having the power of locomotion, it is still more so now, as its position is simply that of a waiting one, generally fixed in one position. The pupæ of butterflies are generally attached to the underside of a leaf, those of the moths are either enclosed in cocoons or else buried in the ground. Several of the pupæ of butterflies have been found to possess the power of adjusting their colours to those of their surroundings, notably that of the Peacock butterfly (*Vanessa Io*) which appears in two forms, the common form light grey, and the rarer bright yellowish green. The pupæ of nearly all the members of this family have brilliant spots of burnished gold on the pupa case. In a series of interesting experiments on the pupæ of the Small Tortoiseshell, Mr. Poulton found that this species was very susceptible to surrounding colours. By the use of black surroundings in the caterpillar state, he found that the pupæ were, as a rule, extremely dark, with only the smallest trace of the golden spots. On using white surroundings, the very opposite result was produced. The black colouring matter, asa rule, was absent, and there was a great development of the golden spots, so that in many cases the whole surface of the pupæ glittered with a metallic lustre. The pupæ of *A. Iris* (Purple Emperor) although of considerable size, is protected by the effect of shadow gained by an arrangement of colour. It spins up on the under side of a sallow leaf. Last year I had a caterpillar sent up from the New Forest, and with the help of Colonel Le Grice, I was fortunate enough to rear it. It was very difficult to distinguish from the leaf, the effect of the colour being to give it a flat appearance.

The cocoon spun by the caterpillar of the Emperor moth is very interesting. It is pear-shaped. and composed of brownish silk, and is so constructed that the newly emerged moth can easily walk out of the small end without breaking a fibre, while the entry of an enemy from without is impossible. The manner of constructing it is that a number of stiff threads are made to project from the small end of the cocoon, and these converge as they pass outwards, so that the ends are all near together. The other portions of the cocoon are of compact silk, and any insect intruder that ventures to enter by what we may term the open end, is met by a number of spikes, as it were, that repulse it at every attempt. The cocoon of the Puss moth is made of far different material. The caterpillar spins up on the bark of willow trees, and makes a covering for itself out of small pieces of the bark, which it makes so like an ordinary excrescence, that it is very difficult to detect. The consistency of the cocoon is so hard that it is difficult to pierce it with a knife. How, then, does the moth escape. As soon as the moth emerges from the pupa case, it ejects a fluid, and softens one end of the cocoon, and thus makes a small hole out of which it slowly

creeps. If one of these caterpillars is kept in confinement, without access to any kind of bark, it will make its cocoon out of all sorts of miscellaneous objects, even making it out of pieces of highly coloured ribbon.

We must now turn to the last stage of the butterfly or moth's life—that of the perfect insect. Here we have again protective resemblance, warning colours, and mimicry. As a familiar instance of protective resemblance, I would mention that of *Thecla rubi* (the Green Hairstreak). This pretty little insect is fairly common in the Warren. The upper sides of the wings are of a very dark brown, but the under sides are of a bright green. When seen on the wing it is easy to distinguish, but directly it alights on a hawthorn bush or on the guelder rose it is lost to sight. This apparent disappearance is brought about by the butterfly closing its wings over its back, so that the undersides harmonize exactly with the leaves on which it is sitting. Among our British moths the Buff tip (*Phalera bucephala*) is a very interesting example of protective resemblance. When found at rest, sitting with its wings folded closely round its body, and its antennæ tucked under its wings, it looks just like a piece of stick, or a projection of the bark on which it sits. Many butterflies resemble dead leaves on their under side; but this form of protection attains its greatest perfection in the tropics. In the Malay islands there are some large and showy butterflies, orange and bluish on the upper side, frequenting dry forests. They always settle on dry foliage, and in that position exactly resemble a dead leaf. This is effected by the butterfly settling on a twig, with the short tail of the hind wings just touching it and forming the leaf stalk. To still further complete the resemblance, the wings are covered with small black dots, so exactly resembling the minute fungi on dead leaves that it is difficult to believe that the insects themselves are not attacked by some such parasite. Another has its wings so formed that it has the appearance of having had a portion of them eaten away by some larvæ or other insect.

Other forms of protection are those afforded by mimicing wasps and bees, and unpalatable species of their own order. As an example of the first kind, I may mention some of the hawk moths, and the clearwings (specimens of which can be seen on the platform after the lecture.) This is especially the case of *Specia apiformis* (sometimes called the Hornet moth.) As it sits sunning itself on the brink of poplar trees, it looks extremely like a hornet or large wasp, which is rendered more unpleasantly lifelike by the habit of moving its abdomen as if in the act of stinging. The whole family of the Cesidæ (or clearwings) bear striking resemblances to different kinds of flies. As I was hunting for one of the species last

summer (S ichneumoniformis), I was often puzzled by a fly which was exactly like the moth I was after, and on more than one occasion I caught the fly instead of the moth. Mr. Bates, in his "Naturalist on the Amazon" says, that he several times shot by mistake a humming bird hawk moth instead of a bird. This moth *Macroglossa Titan*, we have a representative of the family in England called *Macroglossa stellatarum*, is somewhat smaller than the humming bird; but its manner of flying and way of poising itself as it sips the honey from a flower, is precisely the same as the action of the humming bird. Mr Bates says that the resemblance has attracted the attention of the natives, all of whom, even the whites, firmly believe that one is transmutable into the other. Many tropical butterflies mimic others of allied species which are inedible. A remarkable instance of this is given by Mr. Poulton in his work already referred to. It is a swallow tail; but the females are without tails on the hind wings, and present a totally different appearance from the male. The female occurs in three different varieties, each of which mimics a different species of *Danias* (an inedible butterfly) prevalent in its district. It is noticeable that females are far more liable to assume this method of defence than the males. As a rule they fly slower, and are more liable to attack when in the act of depositing their eggs.

Among other orders of insects there are many examples of mimicry; but I will cite but one or two. To again quote Mr. Poulton: "One of the most interesting cases I have yet met with was found by my friend, Mr. W. L. Sclater, in tropical America. In this part of the world leaf cutting ants are only too well known, being most destructive of the introduced trees. They are seen in countless numbers passing along their well worn roads to the formicarium, and every homeward bound ant carries a piece of leaf, about the size of a sixpence, held vertically in its jaws. Mr. Sclater found an insect of an entirely different kind, and, I believe, belonging to a different order, which mimicked the ant, together with its leafy burden. The piece of leaf was imitated by a thin, flat expansion, and the resemblance was so striking that Mr. Sclater's servant, who was a keen observer, actually believed that he was looking at an ant carrying its piece of leaf." Several spiders imitate ants; and among the grasshopper order many examples of protective resemblance will be found, notably those of "leaf insects" and "walking-stick insects." These latter hold their limbs irregularly, so that the resemblance to a dead branch with lateral twigs, is rendered all the more perfect. To conclude my examples, in Java there is a beetle which imitates closely a large black wasp. Contrary to the usual habit of beetles, it keeps its wings expanded in order to show the white patch on their apex.

I have thus brought before you, in, I fear, a very imperfect manner, some of the many ways in which insects are able to escape from their enemies. The forces tending to their destruction, on the one hand, and their preservation on the other, are often so nicely balanced that it is only by putting forth fresh means of defence to meet attacks that some species are able to survive at all.

Into all the causes that have produced so many and varied means of defence, I have not the time, much less the ability, to enter to-night. But I think we may take it that on the whole they have been carried out by a process of natural selection, and that after all it is a question of the survival of the fittest. May I conclude by expressing the hope that I have awakened such an interest in the study of insect life that some ef our members may be induced to take up some of those branches of it that at present are not worked by any, viz., those of the Coleoptera, Hymenoptera, Diptiera, &c., which are of an equally fascinating and interesting nature.

After a vote of thanks had been accorded, a short discussion ensued.

April 23rd, 1895.

Fifty members present. The President in the chair. Dr. H. G. Knaggs read the following instructive and interesting paper on

VARIATION IN THE LEPIDOPTERA AND ITS CAUSES.

I find myself rather in a fix. I am suffering from an *embarras des richesses*. When my friend Mr. Sydney Webb kindly promised to lend me specimens to illustrate this lecture, I sketched out this paper and sent him my requirements, but I was quite unprepared for the grand consignment of rare varieties, many of which are quite unique, which Mr. Webb has, only this morning, generously confided to my care. Time is short, and to do these justice a volume would be required. I should like to have told you a lot about them, but I am afraid that what I have already scribbled out will be more than enough to weary you, and it is too late to write it over again. However, I hope that the rare chance of seeing a selection of the jewels of the finest British collection in the world will somewhat atone for my own shortcomings. I have avoided all technicalities, and in order to keep within reasonable limits, have discarded as far as possible all malformations, freaks, and sports, and have confined myself as religiously as I could to my text, namely, "Variations and their Causes."

In the first place, many species present such divergent forms

amongst the individuals that they have received separate names, until by rearing from the egg, or otherwise, they have been proved to be identical; it may be that the male bears no resemblance to the female, as in the vapourer, the large lackey, the spotted muslin, the clouded buff and many others; it may be that there are two distinct forms of the male or of the female; this is far commoner with the latter sex, examples of which may be observed in the dark form of the silver-washed fritillary, and the pale form of the clouded yellow. There may be three separate forms or there may be many, as in the case of the buttons, of which latter there are a large number of named varieties, as will be seen by an examination of a collection of them kindly lent by my friend Mr. Purdey.

Of far rarer occurrence is confusion of the sexual markings. It may be that the characters of both are represented on the same individual, either laterally or intermingled, or that the male has the colours and markings of the female, or vice versa. Another curious variation in colour is a shot appearance presenting one tint from one direction, another from another; of course, I mean in an insect which does not ordinarily show this peculiarity.

A form of variation most intimately connected with the subject of this lecture, is that which takes place according to the season of the year at which the butterfly or moth makes its appearance. Of this we have examples in the spring and summer brooded thorn moths and mochas, and in the summer and autumn brooded comma butterfly.

Local variations or races are peculiarly interesting, and throw much light upon the workings of nature—examples of all these are shown in Mr. Webb's selection. Of these we have those which inhabit hills, dales, fens, moors, woods, plains, sandhills; northern, southern, western, eastern, peaty, chalky, and sandy districts, or which are otherwise restricted in their areas of distribution and separated from the parent stock of their species. Especially under this heading may be mentioned the island forms, which are perhaps the most instructive of all. It has been noticed, too, that immigrants and importations exhibit a tendency to variation, if they succeed in gaining a foothold on the new soil. Similarly, when species are bred at home in our cages generation after generation, there is an indication of departure from the type, though this is generally in the direction of deterioration.

When nature has established a variety which has become stable, heredity continues the work, and with this material and by judiciously crossing different strains, avoiding the typical form as much as possible, it is within man's power to produce other variations. In '67. I suggested that hereditary influences might be turned to account as well by the variety breeder of insects as by

the Herefordshire farmer or the pigeon fancier, by the careful selection of parent stock, with a view to peculiarities, whether structural or ornamental, being reproduced in the progeny. Of late years there is a tendency to apply this treatment in a practical manner, and no doubt results of a kind approaching those obtained by the breeders of animals and birds, possibly even as singular as those of the horticulturist, will be the outcome. Here are several varieties of the buff ermine, one of which has been recently produced in this manner, and another evidently the offspring of the crossing of a variety peculiar to York with another peculiar to Heligoland. These have been kindly lent by my friend Mr. H. A. Auld.

Let us now enquire why it is that a species when isolated, restricted to a limited area, and separated from the parent stock, shows this tendency to variation. The answer would appear to be that the surroundments, such as natural enemies, soil, food, climate, and other atmospheric conditions, differ from those to which it had been previously accustomed. First, take natural enemies; to counteract the evils of which natural selection and mimicry come so prominently into play, as has already been ably explained to you by our friend Mr. Stuart Hills, and which therefore requires no repetition on my part. But there is one curiosity in connection with non-fatal injuries of enemies, to which I should like to call your attention; it is that when the damage done by ichneumon or other assailants, or by accident, to a caterpillar or chrysalis is insufficient to kill, though serious enough to cause destruction of portions of the wing in the perfect insect, a new fringe is grown on the mutilated edges of the wound. This is mentioned as a curiosity, not as a variation. Another very interesting point is mentioned by Dr. Chapman in the "Entomologist;" it is that injury to the chrysalis by pressure will cause the portions suffering from this rough treatment to become bleached in the perfect insects, and he instances the case of a red admiral chrysalis thus accidentally squeezed, in which a white patch crossed the red band of the upper wing of the perfect insect, and a corresponding change was evident on the lower wing. This cause of bleaching may possibly account for the mysterious white blotches so frequently noticed on the wings of the meadow brown—a condition which has usually been accounted for by sun burning.

Then the soil has been supposed to exercise a chemical action through the vegetation of the locality in such a manner as to produce dark varieties on a peaty soil and pale ones on the chalk; but all sorts of chemicals and dyes have been tried without producing any appreciable effect upon the adult insect; at most, semi-transparent caterpillars have shown a blush of the colour

through their skins or the silk of the cocoon has been tinted. No, it is more rational to account for the phenomenon by natural selection, and to come to the conclusion that those insects which resemble the colour of the soil upon which they settle will be more fully protected from discovery than those less fortunate relatives, which are unable to conceal themselves, and that heredity will complete the work. Something of this sort evidently occurs in the neighbourhood of coal mines and smoky manufacturing cities, where negro varieties are mostly to be found.

Food has pretty generally been looked upon as an important factor in producing variation, but in the present day its influence is considered very feeble; still, there is evidence to show that it possesses a certain amount of power. We have accounts of a diet of madder causing some species to be turned brown. Certain grasses are said to darken the colour of the drinker moth, pale tiger moths are stated to be bred from lettuce, dark ones from coltsfoot, yellow Brussel's lace moths from yellow lichens, besides many others which require the confirmation of repeated experiments; but there can be no doubt that *feeding* is productive of considerable modification in the perfect insect. Feeding over an extended period, particularly if followed by a long duration of the chrysalis state, yields the finest moths and butterflies, those which are fed up quickly under the stimulus of warmth and fresh juicy food are comparatively small. Starvation will change the tone of the colour to a sickly yellowish hue; it will also render dull the bright tints, and of course dwarf the specimens. Irregular, careless feeding, sometimes with an abundance of fresh food, at others with nothing at all, or at the most with dry stale food, has been known to produce varieties of such species as can survive the treatment.

Light, or the deficiency of it, was at one time expected to exert an influence, but no satisfactory results have been recorded. With decomposed light, my old friend, the late Edward Hopley, some thirty years ago, made a series of experiments by covering his jam pot cages with different coloured glasses, but the outcome was of a negative nature. I did a little myself in that way, with similar provoking results; but I found that I could induce noctural caterpillars to feed in the daytime by covering the cage with blue or green glass, and thus make them feed up more rapidly. The wonderful effect of altering the colour of the chrysalis to pale, dark or gold, or its cocoon to the tint of the surface upon which it spins up by compelling the caterpillar to change in a box lined with coloured or gilded paper, described by Professor Poulton in his charming book on Colour, is most interesting, but it is not followed by any appreciable variation in the perfect insect.

We now come to atmospheric influences, and here we find that in degrees of temperature acting upon the chrysalis, we possess the most powerful agent yet discovered to produce variation; but before discussing this, let us dispose of the other atmospheric conditions which tend to modify the perfect insect.

Easterly wind will sometimes delay the appearance of an insect until long after its proper time for emergence, perhaps compelling it to lie over for another year, and thus indirectly, by prolonging the chrysalis state, be the cause of variation, for it is well known that certain chrysalids, especially those who have fed internally, as caterpillars, will wriggle themselves towards daylight, with the intention of coming out, and then, having had a taste of a north-easter, alter their minds and beat a hasty retreat.

Rain or humidity would seem to operate on the insect about to emerge. By moisture we try to account for the darkness of some species taken in the West of England, Ireland, and the Isle of Man, because it cannot be accounted for by cold, as in the case of Scotch butterflies and moths. We know that if moisture gets between the scales, displacing the air, the colour is altered, and a curious enquiry into the cause of the green of the underside of a green hair streak turning red when wetted, has lately taken place.

Electricity is supposed to be a cause of variation amongst the blues, more particularly those which emerge during a thunderstorm, these being of a beautiful lilac instead of the ordinary blue colour, but it is just possible that the enriching of the colour is due to the oppressive heat which generally precedes a summer storm, and we shall see further on that one of the effects of heat is to convert blue into violet owing to the formation of red pigment. Mr. Sydney Webb, however, says that tortoiseshell butterflies which emerge before a storm are paler, while those appearing after it are darker. (Examples exhibited by Mr. Sydney Webb.)

The French have suggested an apparatus for subjecting chrysalids to the effects of an artificial storm by isolating them in a little sulphur cell and placing them between the electrodes of a battery to represent an electrical condition of atmosphere, and also effecting occasional discharges to represent lightening, but the results have been negative, and the insects which emerged did not seem any the worse for this treatment.

Heat and Cold.—A good many years ago some notes in the French *Annals*, especially one by M. Bellier, de la Chavignerie, written in 1858, attracted my attention. M. Bellier's note ran thus: "One day a friend of mine brought me several tortoiseshell butterflies, which, owing to the wings being excessively dark, and adorned with large, intensely black spots, immediately excited my admiration. He assured me that these remarkable specimens had

been reared from backward caterpillars collected by him in the autumn, and that he had delayed the appearance of the perfect insects by keeping the chrysalids in an ice house."

This statement, taken in connection with the fact that the summer brood of the purple thorn could be made to yield either a second summer brood or a spring brood at will, by merely hasten- or delaying the appearance of the perfect insect, induced me to suggest, in some notes on "Variety Breeding," which I was writing in the "Entomologists' Monthly Magazine" in 1867, that the power of heat and cold to modify the perfect moth or butterfly should be patiently and practically investigated. My remarks created some stir at the time, and Dr. Jordan, one of the best entomologists of the day, expressed a hope that experiments would be made, and the results (negative as well as positive) published.

Still nobody seemed to rise to the bait, till some fifteen or twenty years ago Mr. Merrifield, of Brighton, took up the matter seriously, and by a course of experiments extending over many years, has arrived at startling results, the publication of which has made his name famous throughout the entomological world. The Germans, too, as well as Swiss, Canadians, and Americans, have entered the field, and an excellent paper on the subject, by Dr. Standfuss, of Zurich, has been translated, and is now being published in the pages of the "Entomologist." This latter, so far as it goes, corroborates the results obtained by Mr. Merrifield in a remarkable way, and it is plain that though comparatively very few species have yet been submitted to the action of heat and cold, this method of investigation will prove very valuable in elucidating many points connected with the origin of species and other knotty subjects. In his paper, Dr. Standfuss remarks: "I can truly say that during the period of more than 25 years which I have devoted to practical biological studies in entomology, I have never had before me anything approaching the astonishing results to which I am now referring. Can it be called anything but astonishing that it should be possible, by means of a simple experiment, to make caterpillars of the swallow tail butterfly, collected at Zurich, develop into a form of perfect insect such as that which flies in August in Syria! . . . . Or that from German and Swiss chrysalids of the Camberwell Beauty, by the action of well defined factors, there should be produced a butterfly which in part comes very near the Mexican form! Or to force at will one half of the progeny of one and the same Painted Lady to develop into a form of perfect insect almost identical with that occurring in German Africa, and the other half to assume an aspect like that occurring at the northernmost limit of its range, as, for instance, in Lapland!"

A few weeks ago I spent a most pleasant and instructive day at Brighton with Mr. Merrifield, who was at great pains to explain to me his methods, and to point out the results. It will not be necessary to describe his arrangements for rearing caterpillars on a somewhat wholesale scale; nor need I dwell upon his apparatus for raising or lowering the temperature, further than to say that by extremely ingenious contrivances he is enabled to maintain a temperature steadily between 98deg. and 99 deg. Frhr., or at any other degree of heat he may require; while with a refrigerator he can keep his chrysalids within a few degrees of 44deg. F., more or less, or if a very low temperature be desired an equable cold of 33deg. F. is secured by means of a Norwegian cooker; but Mr. Merrifield tells me that in order to obtain tropical or arctic results, he frequently employs heat or cold to pretty nearly the killing point, when of course the mortality is vastly increased. Somewhere about a month is the usual period of exposure to cooling influences, while the hotter temperatures may either be applied until the insects are forced to emerge, or only for a day or two, after which they can be moved to the temperature of an ordinary room and left to themselves. Mr. Merrifield pointed out that the general tendency of heat was to render the markings more or less indistinct, to develop the yellows, oranges, reds, and browns, at the expense of the blacks, whites, and blues, whereas the converse was the case with cold, from which, in addition, the margins of the wings become more scalloped, and some of the markings assumed a different direction to those observed in specimens which had been submitted to the hot treatment. He said, however, that there were occasionally exceptions to these rules for which he was not yet prepared to account—for instance, it seemed to puzzle him why heat should enlarge the spots upon the fore wings of the small copper, while those of the tortoiseshell were diminished by the same process—but, no doubt, with further experience in this interesting kind of investigation, the apparent anomaly will be cleared up. Considerable differences take place on the undersides of the various species operated upon, the enumeration of which would occupy too much of our time; it will suffice to say that greater uniformity of tint with less definite markings is the general effect of heat, while greater distinctness of markings results from the cooling process.

I shall now try to explain more lucidly by the aid of these rough figures, the respective changes which take place in the perfect insect, as the consequence of subjecting the chrysalids to a high or low temperature.

In the peacock butterfly no great amount of change takes place from heat, but the ground colour becomes a deeper red-brown.

One portion of the blue near the tip is lost, and on the lower wing the outer part of the ring round the eye is obscured by the ground colour; by cold the bluish white marks are reduced; white, black, and a few blue scales appear beneath the reddish ground colour and the border—and the inner patch on the fore margin is extended towards the shoulder—by still more prolonged cold, six weeks, there appears in some cases a black spot on the inner margin corresponding to that in the tortoiseshell, the middle part of the eye acquires black scales corresponding to the end patch in the tortoiseshell. In some instances the eye of the hind wing is almost obliterated.

In the Camberwell Beauty, with 48 hours' heat, the blue spots are greatly reduced in the fore wing, and the yellow border reaches the blue spots. With 60 hours' heat, the blue spots are reduced to half the size, and tinged with violet, the ground colour becomes darker, and the yellow border becomes so much darker that but few yellow scales are visible, the projecting points of the border are not so prominent. With cold the ground colour becomes lighter, spots appear like the two centre spots of the tortoiseshell, the blue spots of the fore wing become much enlarged and ringed with black. With more prolonged cold, the blue increases, the yellow border narrows, and in a few cases the blue spots of the hind wing not only reach the border, but are continued into it as acute projections. With 44 days' cold, the border becomes still narrower, and is much mixed with black scales, the blue intrudes still more into the border, and the ground colour becomes velvety black.

In the tortoiseshell, heat 60 hours, the blue spots on the margin, especially of the fore wing, disappear, as also do the black spots near the centre; the black patch on the hind margin is much smaller, sometimes nearly disappears. With cold, blue spots in the border become larger and well defined; in several specimens a black transverse shade passes from hind patch to front, looking as if nearly half the wing was blackened up to the shoulders. With 42 days' cold the beautiful blue spots are overpowered by black, like the polar variety.

The red admiral, heat 72 hours, blue of the fore wing becomes reduced to two small spots near the tip, red band widens in both directions, abundant reddish shading between the red band and the shoulder. The white spots all reduced in size, sometimes the fifth dissappears. Many examples, too, have red scales between 2nd and 3rd white spots.

With cold, the white spots are much enlarged, the red band is narrowed and divided by two black shades about the middle into three portions; the lower portion of band is also cut off. In ex-

treme cases the lower part of red patch appears almost obliterated with black scales. Blue scales appear between white patch and band, and sometimes on the other side, and hind end, of red band.

I now come to a very interesting continental creature. It belongs to the same group as those to which we have just referred, but it is double brooded, and the two broods are about as unlike one another as can possibly be imagined; the summer brood is brown-black, with a bold cream coloured interrupted band running through both wings, reminding us of our white admiral. The spring brood, however, is tawny orange, with innumerable small dark brown markings, reminding us of our pearl bordered fritillary; these in nature succeed each other; by art, we can alter nature's arrangements, and make the chrysalis which ought to yield the spring brood, produce the summer one. Nay, more, we can alter the size and shape of the spring into the summer form, and then put on the spring colour.

The next sketch illustrates the two broods of the purple thorn, the spring being the upper figure. It will be observed that the outer edge of the dark inner portions joins the front margin at an acute angle. This is one of the effects of cold; so to is the angulation on the corresponding edge of dark mark in the lower wing, as also the production of the tip, giving it a scalloped appearance; the lower, summer brood, you will notice differs considerably in these particulars; by art we can breed from the eggs of the summer form either the summer or spring form, and "vice versa," at our will. But, having produced the spring form, we cannot reinstate the summer shape or markings, though we can alter the dark spring markings into the warmer red hue of the summer brood. Among Mr. Webb's selection will be found an instance of this—this may occur in nature, in art it is effected by first administering a month of cold, then two days at 99deg. F., afterwards the temperature of an ordinary room, say 70deg. F.

From the foregoing it will be seen that this method of investigating the secrets of nature, though yet in its infancy, has even now disclosed some of her workings—has given us a peep into her laboratory, so to speak; and it is reasonable to anticipate, from the startling results already obtained, that when the number of careful observers and diligent students is multiplied, and they get to work to accumulate a further supply of facts, our scientists will set themselves the task of putting that and that together, and we shall reach a far higher standard of knowledge, not only concerning the variation of butterflies and moths, but of other creatures which constitute the animated world, whose variability is still wrapt in considerable mystery

After the lecture, Dr. Knaggs pointed out the wonders and

beauties of Mr. Sydney Webb's selection of insects, which he (Mr. Webb) had most thoughtfully arranged with infinite pains, consisting of the following: six species where the males differed exceedingly from the females; four species, in two of which there were two forms of the females, and two with two forms of males; nine species in which either the male took on the female, or the female took on the male plumage; four species representing seasonal varieties; six species showing the differences in the insect of the north, west, and south of England, the Shetland hills, and also four sets of varieties of the annulet, illustrative of the change of colour in limestone, sandstone, peaty, and chalky districts; six species showing absence of colour pigment, and six species showing excess of pigment; eleven species with a tendency to obscuration by dark scales and smokiness; ten species in which the red coloured markings have been either mixed with or converted into yellow, greens converted into orange, and white saturated with yellow; six species where the markings have been suppressed or run into one another; a series of five specimens of the peacock butterfly, demonstrating the gradual diminution of the eye-like spots, and final extinction of these on the lower wing: a long series of the ringlet, exhibiting on the under side enlargement of the ring-like spots and dots on the one hand, and diminution to the vanishing point on the other; other specimens of the same family, showing the increase or suppression of the eye-like spots on the upper surface; four species in which the dark markings have been more or less suppressed, and the light markings consequently rendered more prominent; a specimen of the painted lady in which the white markings at tip have been replaced by the ground colour; six species representing the effect of starvation; a series of tortoiseshell butterflies showing the difference between those which emerged before and after a storm respectively; three species representing the effect of cold; eight species showing the effect of sun burning or bleaching; a series of magpie moths with united spots; four species exhibiting the rare occurrance of being male on one side, and female on the other; six monstrosities; and two species showing how a new fringe has grown on the mutilated edge of a portion of the wing destroyed by ichneumons.

The enlarged water colour drawings of the butterflies and moths referred to above were executed by Dr. Knaggs' son-in-law, Mr. C. C. Hodson, and his wife and sister.

May 28th, 1895.

The President in the chair. Forty members present. Mr. G. C. Walton, F.L.S., read the following paper on

PINES AND FIRS,

Which was illustrated by numerous fresh and dry specimens obtained chiefly in the neighbourhood of Folkestone.

The title of this paper must be taken to stand for all trees and shrubs that belong to the natural order "Coniferæ," the order of cone-bearers. As you have an order of pod-bearers, so you have one of which the fruit is called a cone, because in shape it is often more or less conical. While, however, a pea pod is of very simple structure, a cone is a typical compound or collective fruit. In this respect it resembles a pineapple, a compound fruit which owes its name to its outward resemblance to an unopened pine cone. A cone consists of an axis round which are arranged scales and bracts which bear ovules on their upper surface. A diagram, or better still, a specimen, will show that these ovules are not enclosed in vessels (as a pea is enclosed in a pod), but are without any covering, except bracts and scales, the former being looked upon by most botanists as open carpellary leaves. The ovules are the future seeds, which, not being enclosed in a fruit, are called "naked." As the seeds of many species do not ripen the first year, they remain for months covered up by the scales (which overlap each other like tiles on a roof), and are not exposed until the scales separate.

Lindley, in 1833, grouped the Coniferæ and Cycadeæ, and called them Gymnospermia (naked-seeded plants), and, as such, together with the order Gnetaceæ, they are still known. These three orders are of very great interest, and they are somewhat of a puzzle to the systematic botanist who wishes to give them all the importance they deserve, and no more. They are usually put *above* the monocotyledons or endogens. But some think they should be put *below* them, and be looked upon as coming between the flowering and flowerless plants. Why this should be, is by no means plain to the non-botanical; but reasons, more or less satisfactory, can be given for many things, and for this amongst them. Geology teaches that gymnosperms grew on this earth of ours long, long before the monocotyledons, and much longer still before the true dicotlyedons, and partly from that fact the evolutionist argues that

the spore-producing lycopods and the seed-producing gymnosperm had a common ancestry. What that ancestry was, I must really ask you to find out, just, however, giving myself the gratification of throwing one difficulty in your way, and it is this—rocks as old as the Carboniferous tell us of gymnosperms as *highly organised* as those we see growing to-day. The evolutionist, however, seeks other aid than that of geology. He goes minutely into the structure of the pollen grains and the ovules, and notes the peculiarity of the embryo, and the mode of fertilization and germination, finding a good deal of suggestion as to the affinity of conifers with the vascular cryptograms, especially selaginellas. Modern text books insist upon this affinity—one of them in these words: Gymnosperms are quite as closely allied to the higher Cryptograms as the divisions of the latter are to each other.

How easy it is to see that in any special branch of study one man builds on another man's foundation. Robert Brown, that prince of botanists, in the early part of this century, was the first to enquire closely into those structural peculiarities that have since been more fully studied, and have led botanists to those conclusions that are now generally accepted.

I will now briefly take you through the leading characters of the order of the cone-bearers, and then pass on to informatien of a more general kind.

Coniferæ.—A family of trees or shrubs comprising about 30 genera, and about 300 species, of *exogenous* habit, and usually *resinous*, and with few exceptions, *evergreen*. Wood with indistinct medullary rays and *no true vascular tissue*. Cells of the wood disc-bearing, that is to say, furnished with circular markings, which are not found in other kinds of wood (these discs are easily seen under the microscope). Leaves usually linear, like those of grasses, or needle-shaped, or small and scale-like. In *Pinus*, much the largest genus, the needle-shaped leaves are either in *pairs*, as in the Scotch pine, or in clusters of *three* or *five*. In the larch, one of the most valuable of conifers, the leaves are in clusters and deciduous. In arbor-vitæs and others, the leaves are very small, and overlap like green scales. Flowers of *two kinds*, usually on the same trees. The stamen-bearing ones arranged in catkins, very *simple* in structure (as in willows). Calyx and corolla none. Pistillate flowers, if they may be called such, *without perianth* and style, consisting of a *single* naked ovule, or of a *number* of ovules. Fruit, a more or less woody cone, a berry-like modification of the cone (called a galbulus), or a *solitary* naked seed, seated in a sort of cup. Seeds often winged. The relationship of a pine cone to a juniper berry and the fruit of the yew is not, at first, clear, but it is very real. Look at the so-called berry of the *yew*. There is

a *solitary* seed, partly covered by a pulpy substance. Look at the so-called berry of juniper. It consists of a few scales which become *fleshy* and close over the seeds. Look now at an ordinary cone, with, perhaps, *scores* of naked seeds, and the family tie comes into view. It must be said, however, that while all botanists call juniper a Conifer, not a few have placed the yew and its near allies in a distinct order called Taxaceæ. Bentham and Hooker, the distinguished authors of "Genera Plantarum," a work which occupied many years in its production, includes the Taxads, and arranged Conifers in six sections, *three* of which are represented in the Flora of Great Britain, each one by only one genus, and each genus by only one species. The species naturally produced here are the Scotch pine (*Pinus sylvestris*), the Juniper (*Juniperus communis*), and the Yew (*Taxus baccata*). Of that Scotch pine many things might be said. It is naturalized in the South of England, but it belongs to Scotland, where it is still a feature, though not nearly as much as it once was. It formerly abounded in Ireland too. It is rather plentiful in this neighborhood, producing cones very freely. Juniper is interesting to the distiller of gin. It is usually a low shrub, but sometimes a small tree, found in many English counties. It *did grow* sparingly about here, but I should not be sure of finding it now. Its name is traceable to Latin words meaning "youth renewing," or "young producing," because of the evergreen character of the genus. And the yew tree! What associations it has. Did not English archers in the olden time, fight and conquer with their bows of yew? Did they not continue to use the bow for a long time after the invention of gunpowder, and was there not often a space of some two or three hundred yards between the bowman and the mark whither his arrow flew? On other grounds, much interest centres in the yew. It is not a light cheery-looking tree, but still a very long-lived one, and it has long been planted, as its branches have been carried, as an emblem of immortality. The words of Shakespeare are fitting in this connection,

> "My shroud of white, stuck all with yew,
> Oh prepare it."

The *leaves* of the yew are poisonous, but *not* so the scarlet so-called berry. But few conifers were introduced into this country before the sixteenth century, and many of those that adorn our parks and plantations are of recent introduction. Only some fifty or sixty years having passed since our landscape gardeners, in all parts of the country, were on the look-out for those new trees and shrubs which the bold enterprise of our fellow countrymen was making known to them. The mammoth tree of California, now called *Sequoia gigantea*, but still better known as *Wellingtonia gigantea*, and

in America as *Washingtonia californica*, was discovered and introduced by Mr. Lobb. Some of you may remember that it caused no small sensation. It is the largest of Conifers, and one of the largest of trees; all things considered, *the* largest. There grow on Mount Etna some enormous chestnut trees, some of them said to measure a hundred and eighty feet round. Such size of trunk is altogether exceptional, but the mammoth tree—the king of the giant trees of California—has a diameter of as much as thirty or forty feet, and a height of from two hundred and fifty feet to four hundred feet. Try to grasp these huge dimensions. The tallest trees in Europe reach about one hundred and eighty feet, and the tallest in England are not much over one hundred and twenty-five feet. The mammoth tree in the British Islands does not tower above its brethren, for it rarely exceeds *eighty* feet in height. The leaves of this great tree are small, and the cones are only about two inches long. Not far behind the "gigantea" comes its brother, *Sequoia sempervirens*, the Redwood, also a native of California, and a tree of great value. For majestic growth and interesting association, the Cedar of Lebanon has long been celebrated. It was always highly esteemed, and, even now, the Arab considers it possessed of consciousness, and as being a divinity in the form of a tree. From the mountain forests of Northern India comes the picturesque Deodar or Himalayan cedar, considered a variety of the Lebanon cedar. This tree now adorns many a British pleasure ground, and is a great favourite in England. It reaches a height of about seventy feet, and, in its native soil, as much as two hundred feet, with a diameter of eight or nine feet. The word "Deodara" means "Tree of God," or "Divine Tree." The Thuyas, or Thujas, are well known in England as arborvitæs. The names they bear in Japan and China have the same meaning as the Latin, namely, "Tree of life." There is a Cypress so well known that gardeners often call it by its specific name—"Lawsoniana." It is a handsome fellow in *Britain*, but what can be said of it as it luxuriates in its native Californian soil, reaching a height of over two hundred feet, with a diameter of ten or twelve feet. A remarkable Chinese tree, with an odd name, is widely planted in Britain. It is the Maiden-hair tree (so called from the shape of its deciduous leaves), or *Ginkgo biloba*, or Salisburia adiantifolia. The word "Ginkgo" means full of leafless buds in winter. This remarkable tree, geologists tell us, is a survival from very remote times, and it cannot be distinguished from fossil specimens from old strata. The same indeed may be said of some other species which must have existed in the soil of our own land, such as it then was, ages and ages ago. There is a New Zealander, called the Kauri or Cowrie pine, a great ornament to the forests. It

grows to the height of one hundred and fifty feet, with a diameter of eight or ten feet. It yields a great deal of valuable resin, which is closely like that which is found in a fossilized form in districts where the tree no longer grows. Amber is the fossil resin of an extinct pine, and there is no doubt that the good state of preservation of some coniferous wood is due to the resin it contains, and does not the protective nature of their resin account for the hardiness of the Conifers as a family? The common Cypress *(Cupressus sempervirens)* is famous not only for its size, but for the great age it attains. Its timber is rarely attacked by insects, and is so durable that it lasts hundreds of years. An Italian specimen of great size was looked upon as a veteran as long as six hundred years ago. The "Monkey tree" of Chili is peculiar among Conifers, if only on account of its broad sharp leaves, which are "too much of a good thing" for the monkeys, for they cannot climb the tree. Hence the native name of it means "monkey puzzle." Botanists call it *Araucaria imbricata*. It has the staminate flowers on one tree, and the fertile flowers on another, like our willows. This cone-bearing tree reaches a height of one hundred feet, and furnishes a large supply of edible seeds, much prized by the natives. The largest tree in Japan is a conifer called *Cryptomeria japonica*. It reaches a hundred and twenty feet in height, and forms the chief part of many forests. The cones are in shape and size like marbles, but rather prickly, and the wood, like that of many other trees of the order, is not only of a rich colour, but very fragrant. The common Larch must not be forgotten, for it is one of the *most valuable* of trees. The Weymouth pine *(Pinus strobus)* is a great handsome tree, with silvery leaves. The giant (or sugar) pine towers up three hundred feet, and is of large diameter. It yields a clear exudation, with a sugary taste, and has cones from twelve inches to eighteen inches long. A tall and showy tree is the Virginian juniper, or pencil cedar, so called because its rich-coloured fragrant wood is very largely used for pencils, or cedar pencils, as we often call them. Several other pines, by which is meant true pines, as distinct from spruce firs and silver firs, must be almost passed over, although they are stately trees and of very great value. Their names are suggestive—*Pinus australis*, *pinus canariensis*, *pinus excelsa*, *pinus insignis*, *pinus longifolia*, *pinus muricata*, *pinus pinaster*, the huge *pinus ponderosa*, and the Corsican pine, *pinus laricio*. A variety of this last is called the Austrian pine, which is largely planted on the Lower Road, and is a good tree for such a situation. In the spring the whitish shoots contrast well with the rich green of the old leaves, and the trees are handsome so long as they are left alone. Their branches are in tiers or whorls, which give them a very regular appearance;

but when two, three, or more of a ring of branches are cut off, the remaining ones grow large, and the result is a shapeless bit of deformity, of which illustrations are plentiful under the Folkestone Leas. The Silver Firs, species of *Abies*, are entitled to a prize, for they are grand and fair, one of them being the largest of European conifers. The "silver" means that on the under side of the leaves there is usually a shining silvery line. "Abies" comes from the Latin "abeo," "I rise up," or "spring." There are at least five species that rise up over a hundred and fifty feet, three of them often not stopping short of three hundred feet. Such names as amabilis (lovely), magnifica (magnificent), grandis (tall), and nobilis (noble), tell their own tale.

Such great trees as have been mentioned are indeed very grand, impressive, and awe-inspiring. Their great "length of days" stands out in bold contrast to our three score years and ten. Many conifers are *beautiful*, although they have no gay petals like the rose. They may be only green, but

> "Green is to the eye what to the ear is harmony,
> And to the scent the rose."

But the green is not all, for in the spring time it is often brightened up by the very conspicuous colours of the pollen-bearing flowers as well as the different hues of the young shoots. And there are in many cases striking varieties which are pleasing to the eye and interesting to the gardener, but puzzling enough to the student. An illustration of this is found in the yew, for of this well-known tree there are numerous varieties, and, as varieties require names, there is a great heaping up of Latin, and not a little confusion. It is quite enough for a botanist to learn the names which indicate what are believed to be real species, and he may very well leave the rest to people who make a special study of this or that particular class. Many conifers are as useful as they are ornamental. Indeed, it is not possible to over-rate the value of this order, as a whole, for it supplies the builder with a very large part of the timber he requires. All the varieties of deal are the produce of pines and firs, and so are resin, tar, pitch, and turpentine. The ship builder knows the value of the long straight stems of pines and firs, for of these are made the masts of ships, as well as the deck planks, spars, beams, and so forth. Milton ("Paradise Lost," Book I.) speaks thus of Satan, "the superior fiend":

> "His spear, to equal which the tallest pine,
> Hewn on Norwegian hills to be the mast
> Of some great Ammiral, were but a wand."

In "The Merchant of Venice" we find Antonio answering Shylock in these words:—

"You may as well forbid the mountain pines
To wag their high tops and to make no noise
When they are fretten with the gusts of heaven."

In "Cymbeline," Belarius says of the "two princely boys":

"They are as gentle
As zephyrs blowing below the violet,
Not wagging his sweet head, and yet as rough,
Their royal blood enchafed, as the rudest wind,
That by the top doth take the mountain pine
And make him stoop to the vale."

The economic value of coniferous timber is very great, and will continue to be so as long as the present order of things shall last. The tanner finds the bark of the larch and other species of great value as a tanning material. Resinous substances of various kinds, often called "gums," seem to be indispensable to the maker of varnishes and polishes. The Chili pine furnishes an abundance of seeds which are eaten by the Arancarian Indians. The Bunya-bunya of Queensland has large edible seeds. The Stone Pine yields edible seeds, which are sold in the markets of Southern Europe, and the Californian nut pine formerly furnished a large supply of winter food. It is often said, and not without good reason, that pines help to make a district healthy. They do so, it appears, by giving out hydrogen di-oxide and ozone, which may be called nature's purifier. It is known that, like the Eucalypti, some of the species are very suitable for planting in badly-drained and unhealthy districts. But I must leave this side of the subject, and go to one that comes under botanical geography. A very interesting enquiry is this, "How came the *distribution* of conifers to be as it is?" Before any answer to this is attempted, it must be noted that they belong in large part to the north temperate region. There are tropical and sub-tropical species, but many of them love the elevated plateau and the mountain side. The western side of North America from British Columbia, down through Washington, Oregon, California to Mexico is the home of conifer grandeur. Thence have come to us from mountain forests and lofty place, many of the giants, the *Sequoia* included, through the enthusiastic toil of a few men, the best known of whom is David Douglas, a great explorer, whose name will ever be held in highest honour by all lovers of conifers. The Douglas fir, the most valuable timber tree of the Pacific region, is named after him. This fir and several others, of which he was the discoverer, are largely planted in Britain, and some of them may be seen in our own neighbourhood. If we had the same conditions as exist on the Pacific coast, perhaps we could have trees three hundred feet high, but, in trees, as in many other things, we are not so *tall* as our

friends in the West. Passing over Europe, I must take you as far east as China and Japan, and the country north of China proper. There we have another and a most interesting home of conifers. Indeed, Japan in particular is rich in them, having as many as 41 species, of which number about twenty *belong* to the country; some of them being true pines and firs, and others arbor vitæs, junipers, yews and kinds allied to yews, with a fruit more or less, in appearance, like a *plum*. The *Cryptomeria japonica*, already spoken of as a favourite tree with the Japanese, may be seen growing not far from Folkestone with the Douglas fir and the *Wellingtonia gigantea* as neighbours. Of China, I cannot say more than that there are about *twenty* species, whilst others occur a long way up the northern coast. This, then, is an interesting fact in distribution. The species of East and North-east Asia are quite a different lot from those of West and North-west America. There was most likely a time when the Continents were all united in the north, long before the thirty-six miles of water called the Behring's Straits separated Asia from America, and it may be that many species were driven southward during the *glacial period*. But this does not account for so many being peculiar to Japan, and it is therefore believed that this country may be a special centre of distribution. Of the Himalayas and their conifers, I cannot stop to speak. As to India itself, the story is soon told, for no representatives of the order are *native* there. I wish to touch upon a question that comes under the head of physiology. In the main, the pollen of the staminate flowers is carried by the wind and deposited on the ovules. Usually when the *wind* is the agent, the flowers concerned are without colour and scent. The pollen of many conifers is extremely abundant, as may be proved by anyone who shakes a branch of any pine when the pollen is mature. In the neighbourhood of pine forests such a quantity of pollen is shed, that it has been called "sulphur rain." A curious provision is made for the protection of the pollen, until it is shaken out by the wind, when a good deal rises like dust and reaches the young cones, which are often on the upper branches of the tree. I have looked at a good many small cones in the hope of finding some with the scales open, so as to let the pollen reach the ovules, but the scales seem always to be tightly pressed down. They *must*, however, of course, separate sufficiently for the purpose. When the seeds of a pine are ripe and ready to fly away "on the wings of the wind," supported by their own wings, the scales of the cones separate, in some cases springing sharply apart, and away go the seeds—away they go to find a resting place where they may grow. But they do not take their flight in wet weather, for then the woody scales close tightly and shut them in. Thus, you see, it is

protection in all directions. The conifers protect themselves by their narrow leaves and their resin. They, moreover, protect their pollen and protect their seeds.

A hearty vote of thanks was accorded to the lecturer.

OCTOBER 8th, 1895.

The first meeting of the Session was held, the proceedings being opened by a few remarks from the President. Mrs. Eastes and Mr. Walton exhibited beautiful collections of dried plants. Mr. Hambridge some interesting micro-photographs. Mr. Sawyer and Mr. Hills, microscopical objects. Mr. Dalgliesh, some "Jumping beans," the seed of a Mexican *Euphorbia* containing the larvæ of a moth *(Carpocapsa saltitans)*.

NOVEMBER 23rd, 1895.

The Vice-President, Mr. G. C. Walton, in the chair. Fifty members present. The President read the following paper on

"THE MIGRATION OF BIRDS."

I have chosen for the subject of my paper this evening, the Migration of Birds, a vast subject, and one about which there is at this end of the 19th century more mystery and more ignorance, perhaps, than about any other fact in natural history of at all equal importance. The migration of birds is the habit possessed by a large number of them of passing over a large part of the earth's surface twice a year, at a date more or less fixed for each species, generally from a warmer to a colder climate in the spring time, to breed and spend more or less of the summer, and then from the colder climate back to a warmer one, in the autumn, to spend the winter, so that many of these birds live in more or less perpetual summer. This habit has been observed by mankind for centuries, and the oldest notices with which we are most of us familiar are the passage in the book of Job (xxxix., 26): "Doth the hawk soar by Thy wisdom, and stretch her wings towards the south?" and the pathetic passage in the book of the Prophet Jeremiah viii., 7): "Yea, the stork in the heaven knoweth her

appointed times; and the turtle and the swallow and the crane observe the time of their coming; but my people know not the ordinance of the Lord."

The Greek poet, Anacreon, who lived in the sixth century, B.C., sings of the swallow returning to nest beneath the roofs, and bring up its young, in the summer, and then hiding in the winter or seeking Egypt or the Nile; and the Persians and the Arabs compiled portions of their calendar from the coming and going of migratory birds, and held festivals in honour of the warmer season heralded by their return. In the 18th century of our era, birds were supposed to migrate to the moon. There are still a few naturalists who believe that some birds may hibernate through the winter in the same lands in which they have spent their summer, whilst the majority of their species migrate, but I think there is no positive evidence of hibernation published, and the Duke of Argyll, who is rather favourable to hibernation, writes: "I think it clear, however, that migration is the almost universal rule with birds. Hibernation must be a very exceptional circumstance."

There was also a theory that swallows and swifts hibernated beneath the water. This probably had its origin in the fact that swallows are particularly fond of frequenting sheets of water, especially in autumn, at which season vast numbers often resort to reed and osier beds to roost. In skimming to and fro, they often drink or bathe, and repeatedly strike the surface with their wings. This may have suggested a disappearance beneath the surface.

Now let us consider some of the various conditions under which migration is practised. Birds must of course have their plumage at its best to undertake the enormous flight required of them, so that young birds generally migrate as soon as all their feathers are fully developed, and the adults start for their autumn migration soon after moulting. The typical wings of migratory birds are long, and pointed, and flat, and the plumage is generally close and compact. Many migratory birds moult twice a year, in spring and autumn. A very few (common sandpiper) moult in autumn after their migration. The order in which the individuals of a species migrate is generally very regular. Birds, which for some reason or another have not been able to breed, or have accidentally lost their eggs or young broods, leave their summer quarters first. They are the pioneers, the "avant courières" of the migratory army, and they are but few in number. Strange, impossible as it may seem, the young birds that have never travelled before are the next to start! They travel in their first plumage, and often start as soon as they can fly. Later come the adult males, then the adult females, and then birds that have been delayed by accident

or injury. In the spring the order is altered, the adult males leading, the females following, then the young birds, and lastly the injured or weakly ones. The time of day of migratory flight varies a good deal. Some birds migrate by day, but the great majority do so at night or above the range of human vision. The punctuality of the arrival of birds is very remarkable. Some may be looked for almost to the day after a flight of some thousands of miles. The arrival of some sea birds at their breeding places is so regular that it forms a date in the calendar of men most concerned in the event. The date varies much with different species, some arriving earlier, some later, but as a rule the first to arrive are the last to depart, and the last to arrive stay the shortest time, and are the first to leave.

During the height of migration, unfavourable weather will sometimes delay a considerable number of migrants, and then a favourable change will cause an immense rush of innumerable birds, these rushes being more frequent in autumn than spring.

Perhaps on no point of migration is there greater difference of opinion than on the question of speed. Whilst some observers consider 2,000 or 3,000 miles in one night is nothing unusual, others consider about 300 miles in 24 hours to be a good average. Some observers think that birds travel by stages, staying here and there on the way to rest; others that they usually perform the greater part of the flight of 2,000 miles or more in one or two stages. The dotterel breeds on the tundras of Arctic Europe and Asia, and winters in Africa, north of the equator. Its spring migration is late and rapid, and as the bird is scarcely ever seen in intermediate localities during this season (Heligoland records but few in May), we are forced to the conclusion that this enormous flight of quite 2,000 miles is performed without a rest, and between sunset and sunrise. If the dotterel were to start in the evening gloom from its African haunts, say at 7 p.m., it would reach the moors of the Arctic regions, by flying 200 miles per hour, about five the following morning—a record of speed that makes the highest pace of our "Fying Scotchman," "Wild Irishman," or "Dutchman," appear but the creep of a snail by comparison, and of astounding endurance, which may well fill us with genuine admiration and wonder. This account is given by Mr. Charles Dixon in his book, "The Migration of Birds," from which I have derived much of what I am narrating to-night. But, on the opposite page, he has already written that probably migratory birds do not average more than 300 miles per day. I shall refer later on to this question of speed and other disputed points when I tell you of Herr Gätke's work in Heligoland. Let us now consider the height at which birds fly during migration. This is

probably far greater than is usually thought. Swallows and swifts will soar very high just previous to their departure; and migratory birds will drop perpendicularly from the sky with startling suddenness when their flight is arrested by change of weather. Migrants scarcely ever strike lighthouses and the like, excepting during sudden darkness from fog or clouds. Birds may be actually observed migrating as high as they are visible. Gätke mentions rooks on passage so high that they looked like dust, and were only recognized by their cries. Mr. Dixon thinks the greatest gain of this high altitude is the increased expanse of the earth that is visible; but as most migration is at night this seems doubtful. Another possible advantage of which Herr Gätke takes more notice is the diminished resistance of the air at great height, and consequently less impediment to great speed, and diminished fatigue. The currents of air at a great altitude may also be more uniform and favourable, and there may be a greater immunity from enemies. Some species of birds are very noisy during their flight, keeping up quite a chorus of cries. Often in the early autumn have I heard them passing over Folkestone at about 10 or 11 p.m., the cries being usually those of the wader family. Crows travel silently, larks are incessantly calling to one another. Migration is much interfered with by storms. The most favourable wind for this part of Europe seems to be a S.E. wind for birds flying S. or E., and not a wind blowing directly behind them. A great deal has been written about the various routes of migration, and Mr. Dixon says "The great routes of migration, whether over land or sea, are closely connected with the configuration of the earth's surface. We may, for the sake of convenience, divide them into four very marked classes, viz., sea routes, coast routes, mountain routes, and river or valley routes." On this matter, later on, I will read to you what Herr Gätke says. The perils of migration are both numerous and deadly, and due partly to fatigue, partly to the natural enemies each species meets with on its journey, and partly to blunders on the way, and accidents, such as gales and storms. Some ornithologists think that the mortality list of migration is more than 50 per cent., and of those that perish, it is thought that more than half perish at sea. Instances are on record of great numbers of drowned migratory birds being washed ashore, especially after stormy weather. Tired birds will settle on the sails and decks of vessels in the Atlantic, or in the middle of the Mediterranean. Water rails, sandpipers, and cross-bills have flown on board a vessel more than 1000 miles from land. Dixon mentions the arrival of flocks of golden crested wrens on the east coast of England after a stormy passage. He says "Before sunrise on the chilly late October mornings, I have seen

the stunted thorn bushes on the dunes or links for miles along the coast swarming with these tiny creatures—the smallest migrant in the entire palæarctic region. Some have been much more exhausted than others; some have actually rocked to and fro with weakness, as they sat upon the twigs; but the more robust ones were feeding eagerly, and some even indulged in song!" He thinks that these flocks represent only the strongest, and that all their weaker companions have succumbed to the fatigue, and perished at sea. The greatest natural enemies of migrants are hawks, falcons, and owls. The large falcons follow migrating ducks, the smaller hawks live upon the warblers, thrushes, finches, and the like. Hawks will even hunt for small migrants in the rays of the lanterns of the lighthouses. Many of these birds of pray are themselves migratory, and are careful to make their own migrations correspond with those of their victims.

Lighthouses and lightships are a great danger to birds. In cloudy and foggy weather, numbers kill themselves by flying against the glass. Foghorns seem to prevent birds striking. Seabirds rarely strike, except stormy petrels. Here is the report of Mr. Littlewood, keeper of the Galloper light vessel, moored fifty miles off the mouth of the Thames, made on the night of October 6th, 1882:—"Larks, starlings, mountain sparrows, titmice, common wrens, redbreasts, chaffinches, and plover were picked up on the deck, and it is calculated that from 500 to 600 struck the rigging and fell overboard; a large proportion of these were larks. Thousands of birds were flying round the lantern from 11.30 p.m. to 4.45 a.m., their white breasts as they darted to and fro in the circle of light, having the appearance of a heavy fall of snow. This was repeated on the 8th and 12th, and on the night of the 13th, 160 were piched up on deck, including larks, starlings, and two redbreasts; it was thought 1,000 struck and went overboard into the sea." Woodcocks have broken glass 3-8th inch thich by the force of contact. A little grebe (*Podiceps minor*), struck the lantern of the Hasbro light vessel, off the Norfolk coasts, at 11 p.m. on the night of March 30th, 1883, with such force as to split the bird from the neck along the entire length of the body! At the Longstone Lighthouse on November 10th, 1885, "one of the large snipe struck south-east side of lantern at 9.45 p.m., and was almost smashed to pieces." At a lighthouse off Wexford, 1,200 birds were counted as killed in a single night, whilst hundreds more fell into the sea.

The great spring migration of birds may be said to commence about the middle of February. Migration flows and ebbs with the sun. The spring migration advances in the wake of the sun, on his apparent northward course, and in the same way the autumn

migration retreats to follow him to the southern hemisphere. Migratory birds come north to breed, and rear their young in a climate where the temperature is best suited to their several requirements. The adult birds are the first in the spring. The young of the previons year often do not quite reach the usual breeding grounds of their species, and sometimes stay near their winter homes all through the summer. The spring migration is made with greater rapidity than that in the autumn. The birds that go farthest north, leave their southern homes last. The swallows that breed in South Europe begin to leave South Africa about the middle of February, but those that breed in North Russia delay their departure until the middle of April, as though aware that their summer quarters were not yet ready for them. This spring migration lasts till about the middle of June, say four months. Some birds take different routes in spring and autumn. The nightingale *(Erithacus luscinia)*, passes over Heligoland in April and May, but has never been caught there in autumn; the turtle dove *(Turtur auritus)*, passes Heligoland commonly in May and June, but it is much less abundant in autumn. The dotterel *(Eudromias morinellus)*, is rarely or never seen in Malta in spring, but passes that island regularly in autumn. The quail travels by day in autumn, and by night in spring; the common bee-eater does exactly the reverse.

In the autumn the birds that have the longest journeys before them, start first. Young knots *(Tringa canutus)*, and young gray plovers *(Charadrius helveticus)*, begin to pass Heligoland and the British Islands early in August, some even with bits of down sticking to their plumage. Both these birds winter far in the southern hemisphere, reaching Australia, South Africa, and South America, with fly-lines more than 10,000 miles in length. Young sanderlings (*Calidris arenaria*), sometimes arrive on the British coasts at the end of July; their fly line is equally lengthy, extending to South Africa, South America, and the Malay Archipelago. The cuckoo (*Cuculus canorus*), with a fly-line reaching from the North Cape to South Africa, migrates early, passing Heligoland in July. In this species, the old birds begin their autumn migration before the young, an anomaly due to its declining any parental duties. and being therefore free to set off early. Species of cuckoo that nest like other birds migrate in the usual order. Autumn migration lasts also about four months, from mid July to mid November, being at its height in September and October. The great intensity of migration is much more sudden in autumn than in spring, and many more birds are observed on passage. The birds that have appeared earliest in the spring are usually the last to leave; thus the wheatear and chiff-chaff arrive amongst the

earliest of birds throughout their summer area, reaching the British Islands during the last week in March, but are amongst quite the last migrants to leave in the autumn. Whereas the swift and red backed shrike arrive very late in spring, not before May here, and are amongst the first to travel south in the autumn. The number of some birds seen migrating in the autumn is almost incredible. The little bustard crosses the Caucassian Steppes in millions. Flights of skylarks cross certain points in a scarcely broken stream for days and nights together. Prjevalski observed the needle-tailed swift in autumn passage in Mongolia passing overhead for an entire day almost without cessation.

The British Islands are admirably situated for observing migration. They are the summer quarters of vast numbers of birds, the winter home of others, and are situated on the direct fly-line of many that pass over them to breed further north, and return over them in the autumn to winter further south, only staying for a few days on each journey, and being true "birds of passage" for us. They are visited by birds that fly north during the winter of the Antipodes, by birds that come from the far East, and not a few from America. Many rare birds that have taken an abnormal flight are also found on them. Many of the British migration reports read like romance. "Birds striking the lights; birds in countless hosts, drifting by in feathery tides; birds in hundreds exhausted and falling into the sea to perish, or allowing themselves to be taken by the hand; birds passing for days together, literally square miles of them; birds by day and birds by night, flying in regular steady waves or in bewildering rushes; birds following the rays of revolving lamps, or hurling themselves against the dazzling beacons to die, or settling in crowds to rest!" The most important highways of migration in the British Islands are always the coast lines, especially along the east and south coasts, draining a considerable migration from Scandinavia by way of the Shetlands and Orkneys. Land birds skip most of the great indentation of the coast, flying from one headland to another. The valleys leading from the Humber and the Wash are favourite routes to the interior. The goldcrests, that come in autumn sometimes in great rushes, may be traced up the valleys of the Don, and Sheaf, and Trent, almost to their sources. The song thrush and various waders and crows follow a similar course. Birds seem to prefer entering and leaving a country by a low-lying coast, and not by high cliffs. The Dart valley is a favourite route for cuckoos, warblers, redstarts, and flycatchers, returning in spring. The commencement of migration in the British Islands is most noticeable in February, when various birds that have been wintering here begin to pass towards the continent, especially blackbirds,

thrushes, redwings, fieldfares, pied wagtails, meadow pipits, larks, rooks, hooded crows, finches, sparrows, linnets, red poles, and snow buntings. These birds continue to leave for about two months. Rather later starlings, goldcrests, ducks, and waders leave in large numbers. Towards the end of March the migrants from Africa and the Mediterranean basins begin to arrive, such as wheatears and chiffchaffs. In April many more return from the south—warblers, redstarts, the cuckoo, the wryneck, the swallow, and tree pipets, sandpipers, and terns. In May the garden warblers, spotted flycatcher, nightjar, swift and turtledove. By the first week in June, this spring migration has ceased, and about the middle of July the autumn flight is commenced by Arctic waders, flying south over our coasts. Early in August many more help to swell the numbers—knots, grey plovers, common sandpipers, lapwings, ringed plovers, greenshanks, curlews, swifts, wheatears, willow wrens, wood wrens, and whinchats. Early in September, swallows and martins begin to start; ring-ouzels, thrushes, and wagtails also, and still more Arctic waders pass by. By the beginning of October most of our summer birds are gone, and by the end, practically all. During October there is a great rush of birds into and over the British Islands from the west of Asia and east of Europe, consisting of thrushes, larks, goldcrests, finches, starlings, crows, rooks and ring doves, striking on the east coast. Here are some reports from the east coast for October 15th, 1885: From the Farne Isles, off Northumberland, we hear of a great rush of fieldfares, night and day, and the same at the Dudgeon Lighthouse, off the Wash, 200 miles south. Also large numbers of blackbirds by day and night, striking the entire eastern coast line of England for three days, also two large flights of chaffinches, enormous rushes of skylarks for three days, enormous numbers of starlings, and an almost continuous rush of hooded crows and rooks for three days, between the Humber and the Isle of Thanet. In 1882 enormous multitudes of goldcrests continued to arrive right through October. For days and days together larks may be watched arriving into England in a scarcely broken stream, and their cries fill the air all through the night. The breadth of some of these bird waves is almost incredible. They will sometimes strike simultaneously almost the whole length from the Faroe Islands, or the Shetlands and Orkneys, in the north, to the Channel Islands in the South. Having now alluded to most of the facts known about migration in a more or less general way, I wish at this point to bring to your attention a remarkable book written by Herr Gätke, who for fifty years has kept an exact account of bird life in Heligoland, the little island in the North Sea, about forty miles from the mouths of the Elbe and the Weser.

This is a most charming book, and should be read by all lovers of birds. The first chapter is devoted to the course of migration throughout the year, beginning with the guillemots, which visit their breeding places in thousands at the new year, and skylarks and starlings in the middle of January and going through a crescendo movement until May, when fortissimo is reached, followed by the diminuendo of June, and again crescendo of July, August, and September to the fortissimo of October, diminishing again then to the end of the year. In describing the movements in the month of May, after enumerating several species, he writes—"If towards the end of May the weather be specially favourable, most of the above-named species pour in in incalculable numbers; during the hours of night this great host of wanderers sweeps across and past the island without taking rest thereon—some of the birds travelling singly, others in smaller or larger groups according to the nature of the species—all striving to gain their far off homes. After sunrise, however, and during the early hours of the forenoon, thousands and tens of thousands of these birds break their journey; some too at sunset, in order to make a few hours' stay on our island. It is, however, absolutely impossible to ascertain the manner and method of arrival of most of these visitors, even by the most careful observation; this is specially the case with the small song birds and similar species, whose number increases with each minute, without one being able to see a single bird descending from on high, or shaping its course in any one particular direction. Many alight on the fields while it is still dark, and are present in their thousands by the time it has become day-light; some, on the other hand, *e.g.* the bluethroats, arrive shortly before sunrise; others, like the whin and stonechats, arrive only after day has fully begun; from this time onward their number increases steadily, and in so striking a manner, that by ten a.m. all the pastures, fields. and gardens, and even the rubble at the foot of the cliff, literally teem with blue-headed, black-headed, and yellow wagtails, redstarts, chats, wheatears, whin and stonechats, bluethroats, warblers, and reed warblers. The common wheatear is specially numerous on the shingle at the foot of the cliff, and thousands of birds, notably warblers, lurk among the shrubs, and sand lyme grass on the Dune" (a small island close to Heligoland.)

As to October, "Throughout the whole of the month, hooded crows travel in never ending swarms of hundreds and thousands across the island, and for a breadth of many miles, pass both its coasts; cloud-like masses of starlings pass at the same time. At the beginning of the month, if the weather is favourable, the island literally teems with song thrushes, especially during the morning hours. The number of skylarks passing during dark

nights across and past the island in one endless stream, defies even an approximate computation. Fields and gardens simply teem with meadow pipits and chaffinches, so that at each step, in whatever direction, one rouses clouds of them. Golden crested wrens, too, frequently simply flood the island in countless numbers. Chiffchaffs, redbreasts, whitethroats, hedge sparrows, rock pipits, shorelarks, bramblings, twites, and titmice, make their appearance in greater or smaller flights, according to the state of the weather. The nocturnal migration flights which proceed on such a stupendous scale reach their grandest development during the latter part of the month. The silence of the early part of the night is first broken by the solitary note of the song thrush, and perhaps here and there the clear call note of the lark. Then, again, silence reigns for a minute or two, only to be once more broken by the far sounding cry of the blackbird, soon followed by that of a swiftly passing flock of sandpipers. The calls of the skylark rapidly increase in number, smaller and larger flocks of birds being heard approaching, and disappearing near and far. The hoarse cry of the snipe is accompanied by that of the golden plover and of the grey plover the wild scream of the curlew, the cries of the fieldfare, and of the redwing. Next by the sound of hundreds of rapidly-ejeculated cries we recognize a long extending crowd of knots, hastily pursuing its journey accompanied by an incessant din of countless piping, rattling, and quaking voices, unknown to gunner or fowler, and often reminding one of the strain of a creaking cart wheel, many evidently proceeding from the heron and its relatives. The whole sky is now filled with a babel of hundreds of thousands of voices, and as we approach the lighthouse, there presents itself to the eye a scene which more than confirms the experience of the ear. Under the intense glare of the light, swarms of larks, starlings, and thrushes career around in ever varying density, like showers of brilliant sparks, or huge snowflakes driven onwards by a gale, and continuously replaced, as they disappear, by freshly-arriving multitudes. Mingled with these birds, are large numbers of golden plovers, lapwings, curlews, and sandpipers. Now and again, too, a woodcock is seen, or an owl, with slow beatings of the wings, emerges from the darkness into the circle of light, but, again, speedily vanishes, accompanied by the plaintive cry of an unhappy thrush, that has become its prey. Such a migration stream lasts through a long autumnal night, and may be repeated for several nights in succession." In discussing the direction of migration flight Herr Gätke says, "The view, much discussed in recent years, that migrants follow the direction of ocean coasts, the drainage area of rivers, or depressions of valleys, as fixed routes of migration, can hardly be maintained.

Too many facts are directly at variance with this assumption. One of the most salient only—that of the flight of Richard's Pipit may be cited here—"A bird whose breeding home is further removed from Heligoland than that of any other of its numerous visitors. A mere surface glance at the map shows in the most striking manner how many large rivers, in addition to the Ural chain of mountains, this bird has to cross, almost at right angles, in the course of its journey from beyond Lake Baikal to Heligoland every autumn." The main direction of migration flight over Heligoland is in the autumn, from east to west, and in spring from west to east. In the chapter on the altitude of the migration flight, Gätke says, "As long as migration proceeds under its normal conditions this elevation is, in the case of by far the larger number, so great as to be completely beyond the powers of human observation; while we must regard as disturbances and irregularities of the migration movement proper, due to meteorological influences, such portions of it as are brought within our notice." He considers that migration proper proceeds at unknown heights with a tremendous velocity, and for the most part during the dark hours of night. As a proof of the height birds can fly, Gätke mentions that Humboldt on the Andes saw condors flying at a height of from 20,000 to 30,000 feet, or even 40,000. Three birds are named as often migrating only a few hundred feet above the level of the sea—the hooded crow, starling and lark. But he is strongly of opinion that most birds migrate at a height at which they are invisible. The weather exercises a great influence on the height of migration. On a dark night, with a uniformly clouded sky, 15,000 larks were caught in three hours, but directly the moon rose the island became completely clear of birds, which immediately flew at a much higher level.

In estimating the velocity of migration flight, Gätke says:—"My own studies on this subject have yielded results which, in the most surprising manner, surpass all that has been said by Van Middendorf and other writers. Even in the case of so apparently sluggish a flyer as the hooded crow, which it would be ridiculous to enter in a match against a carrier pigeon, a speed of migration flight of no less than 108 geographical miles per hour has been established. The little northern blue throat is proved to be capable of flying 180 geographical miles per hour. It winters in Central Africa, and breeds in about 54 degrees north latitude, and does not stop at all on its way until it reaches Heligoland at about sunrise. Gätke considers that the Virginian plover, in flying from Labrador to Northern Brazil, crosses 3,200 geographical miles in 15 hours, at one flight, *i.e.* 212 miles per hour. In further proof of speed, Gatke says, "Plovers, curlews, and godwits flying across

Heligoland at a rushing speed during bright, warm afternoons in early summer are observed to reach the oyster bed, 22,000 feet to the east, within the space of a single minute," *i.e.* a speed of 250 miles an hour. Gatke does not at all believe in the great fatigue shown by birds after migration, upon which Dixon dwells so graphically. Gatke says:—"After a night's incessant flight, a greater or smaller portion of the succeeding day is all the birds need for satisfying their hunger or recovering from such fatigue as may have resulted from the exertions of their journey. I, myself, that is Gatke, have never noticed cases of fatigue or actual exhaustion in regard to any birds which have landed here during their migration, either by day or night, with the possible exception of three solitary, but interesting instances, in which I observed small land birds resting on the sea, half a mile from the island." As to meteorological conditions, Gatke says, "It is a fact of peculiar interest, that during both migration periods of the year, all species, without exception, approach in largest numbers to the earth's surface when very light south-easterly winds, accompanied by clear, warm weather, happen to prevail for any length of time in the lower regions of the atmosphere." The chief deterrent influence of migration is fog. Dew and hoar frost are also unfavourable to it. As to the order of migration, Gatke says:—"That under normal conditions in the case of 396 species occurring in Heligoland, with the exception of the cuckoo, the autumn migration is initiated by the young birds from about six to eight weeks after leaving their nests. That the parents of these young individuals do not follow until one or two months later. That of these old birds, again, the most handsome old males are the last to set out on the migratory journey." This does not include a few scattered examples of old birds, which have probably lost their mates or their broods, which appear about a fortnight before the young ones, but neither with them nor guiding them. At the end of the first part of his book, Gatke writes: "Both in regard to the immediate cause of the departure of birds on their migrations, and in reference to what guides them, we are confronted with the riddle which has hitherto defied every attempt at a solution, and which indeed we may hardly expect will ever be likely to receive a final explanation. Long and profound study has been devoted to this subject in many quarters, and has resulted in the enunciation of several very ingenious and plausible hypotheses. None of these, however, will stand their ground, when the actual facts, which the life of birds in Nature presents in such abundance, are marshalled against them. In one way or another, however, almost every attempt at an explanation admits that migrants, with regard to the time and direction of their movements, act with a means to an

end, but unconsciously, or, in other words, by instinct. In abstaining from setting forth new theories, I have been guided by the conviction, rendered firmer with increasing knowledge of the phenomena, that what at present has been ascertained in reference to the migration of birds furnishes us with no clue by the aid of which we are enabled to penetrate the depths of this wondrous mystery. The life of man is too short for the complete exploration of this inexhaustible field, and one can only regret that one is unable to start afresh with observations and enquiries from the standpoint which one has reached at its close."

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FOLKESTONE NATURAL HISTORY AND MICROSCOPICAL SOCIETY.

Owing to lack of funds, the publication of the Proceedings of the Society had to be suspended from January, 1896. It has now been thought desirable that a summary of the lectures given since that period should be furnished. This has been put in tabular form on the next and succeeding pages. A list of the officers and present members of the Society is also given.

FOLKESTONE

NATURAL HISTORY

AND MICROSCOPICAL SOCIETY.

List of Lectures, etc., given since the publication of the last Proceedings of the Society, November, 1895.

Date.	Subject.	Lecturer.
1896. Feb. 5. Annual Meeting ...	"Notes on Recent Additions to Museum"* ...	T. EASTES, M.D.
March 3.	"Larks, Finches, Starlings & Crows"	C. H. JOHNS, M.A.
April 21.	"Fungi"	G. C. WALTON, F.L.S.
Oct. 6. ...	"Exhibition of Specimens"	...
Nov. 3. ...	"Rontgen's Discovery" ...	A. H. ULLYETT, F.R.G.S.
Dec. 1.	"Astronomy"	C. H. JOHNS, M.A.
1897. Jan. 12 Annual Meeting	"Microbes and Anti-Toxins"*	C. LATTER, M.D.
Feb. 9. ...	"Swifts and Swallows"* ...	T. EASTES, M.D.
March 9. ...	"Palæolithic Man in Kent and Elsewhere"*	H. ULLYETT, B.Sc., F.R.G.S.

Date.	Subject.	Lecturer.
April 13. ...	"Micro Fungi on Living Plants" ...	B. SAWYER.
April 27.	"Nansen's Voyage in the 'Fram'"	H. W. WATTS, L.L.D.
May 20. ...	... "Palms"* ...	... G. C. WALTON, F.L.S.
Oct. 12. ...	... Exhibition of Specimens ...	...
Nov. 16. ...	"Blue Tit-Mouse"* ...	T. EASTES, M.D.
Dec. 4.	"Salmon-Trout Culture"	G. F. BROCKLEHURST, B.Sc.
1898.		
Jan. 11.		
Annual Meeting.		
Feb. 8. ...	"Toilers of the Deep"* ...	C. H. JOHNS, M.A.
March 8. ...	"Search for Coal in the South-East District"*	H. E. TURNER, B.A., B.Sc.
April 5.	"Movement of Birds in Flight"	C. J. ROBERTS, B.A.
May 5. ...	... Exhibition of Specimens	
Nov. 1. ...	"Some British Birds of the Sixth Natural Order" ...	C. H. JOHNS, M.A.
Dec. 6. ...	"Gault and Greensand" ...	H. E. TURNER, B.A., B.Sc.
1899.		
Jan. 18.		
Annual Meeting ...	Exhibition of Specimens	
Feb. 3. ...	"Movement of Plants" ...	MISS KNIGHT.
March 28.	"Microbial Life in Water Supplies and its Sanitary Significance" ...	C. LATTER, M.D.
April 25 ...	"Distribution of Plants over the Earth" ...	G. C. WALTON, F.L.S.

DATE.	SUBJECT.	LECTURER.
May 16 ...	"A Marine Residence: What was in and around it." ...	T. J. HAMBRIDGE.
June 21. ...	Excursion to Lympne Castle	
Oct. 10. ...	"Courtship of Flowers" ...	H. E. TURNER, B.A., B.Sc.
Nov. 7. ...	"Some Myths of Natural History—Dragons and Sea-Serpents" ...	S. WEBB, F.G.S. (Dover N.H.S.)
Dec. 5 ...	"Natural History Notes on Switzerland" ...	C. LATTER, M.D.
1900. Jan. 9.		
Annual Meeting	"Malaria and Mosquitoes"*	T. EASTES, M.D.
Feb. 6. ...	"Distribution of Plants over the Earth" ...	G. C. WALTON, F.L.S.
March 6. ...	"The Dolomites" ...	CAPT. McDAKIN (Dover N.H.S.)
April 3 ...	"Some minute forms of Animal Life"	T. J. HAMBRIDGE.
May 1. ...	"Influence of Wind on Bird Flight"	C. J. ROBERTS, B.A.
Oct. 2	"Iceland"	H. V. KNAGGS, M.D.
Nov. 6. ...	"Migration of Insects"* ...	S. G. HILLS.
Dec. 4.	"Petroleum"* ...	J. W. STAINER, F.C.S.
1901. Jan. 15.		
Annual Meeting ...	"The Kingfisher"* ...	T. EASTES, M.D.
Feb. 5	"Shells"	C. H. JOHNS, M.A.

Date.	Subject.	Lecturer.
March 5. ...	... "Our Society" ...	G. C. WALTON, F.L.S.
	"Sea-Spider"* ...	... H. F. RUTT.
	"Migration of Butterflies and Moths" ...	S. G. HILLS.
April 2. ...	"Wasps and their Ways' ...	E. CONNOLD. (Hastings N.H.S.)
May 7 ...	"British Orchids" ...	H. E. TURNER, B.A., B.Sc.
Oct. 8 ...	... Exhibition of Specimens	
Nov. 5. ...	"Isles of Scilly"* ...	C. J. ROBERTS, B.A.
Nov. 19. ...	... "Corals" ...	J. MORGAN (of Hastings).
Dec. 3. ...	"Astronomical Notes"* ...	C. H. JOHNS, M.A.

NOTE.—Those marked with an asterisk were published in the "Folkestone Express."

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